WILD FRUITS OF THE PRAIRIES
THEIR CHARACTERISTICS AND SOURCES, PROPAGATION, AND CYTOLOGY.

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GENERAL INTRODUCTION.

Wild fruits would seem to provide promising material for selection and breeding work in horticultural development in Alberta and other prairie provinces. Genera that are available in wild form in the prairie provinces, include the following: Corylus, Grossularia, Ribes, Fragaria, Rubus, Amelanchier, Sorbus, Crataegus, Prunus, Vitis, Shepherdia, Vaccinium, Sambucus, and Viburnum.

An effort has been made in this investigation to locate specimens with characteristics which appear to be of outstanding value and to propagate these plants at the University of Alberta for comparison with other selected plants. Meanwhile, it has been necessary to solve certain difficulties encountered in germination of seed. The considerable variation that has been apparent in the plants of a given genus, or species, collected from scattered points, has been studied from a taxonomic standpoint, particularly with respect to identification of the specimens. A cytological study, especially on chromosome

numbers, has been conducted with the hope of securing information of value in planning breeding work and in relation to the observed variation of characters.

PART I.

CHARACTERISTICS AND SOURCES.

Factors That Affect Distribution.

Distribution of wild fruits in the prairie provinces of Canada has been determined by a number of factors, such as the area involved, elevation, vegetation zones, temperature, and rainfall. These are reviewed briefly to present a preliminary sketch of the scope of the work.

Area.- The prairie provinces extend from the 49th parallel to the 60th parallel and approximately 1,100 miles from eastern Manitoba to the western border of Alberta. The area involved is 753,497 square miles.

Elevation.- Each of the provinces provides a fairly distinct steppe in elevation. The elevation varies, in Manitoba, from 500 to 1,000 feet; in Saskatchewan, from 1,000 to 2,000 feet; and, in Alberta, from 2,000 to 5,000 feet. The first prairie steppe includes the Manitoba plain west of the elevated portion bounded by the Pembina, Riding, Duck, Porcupine, and Pas Mountains. The second prairie steppe extends from the first one westward to a line from longitude 103° 30' and the 49th parallel in a northwesterly direction to Battleford. The third prairie steppe includes the western part of the prairie provinces to the foothills.

Vegetation zones.-

There are three main vegetation zones. They run at right angles to the three steppes and are closely allied with soil types (Fig. 1).*

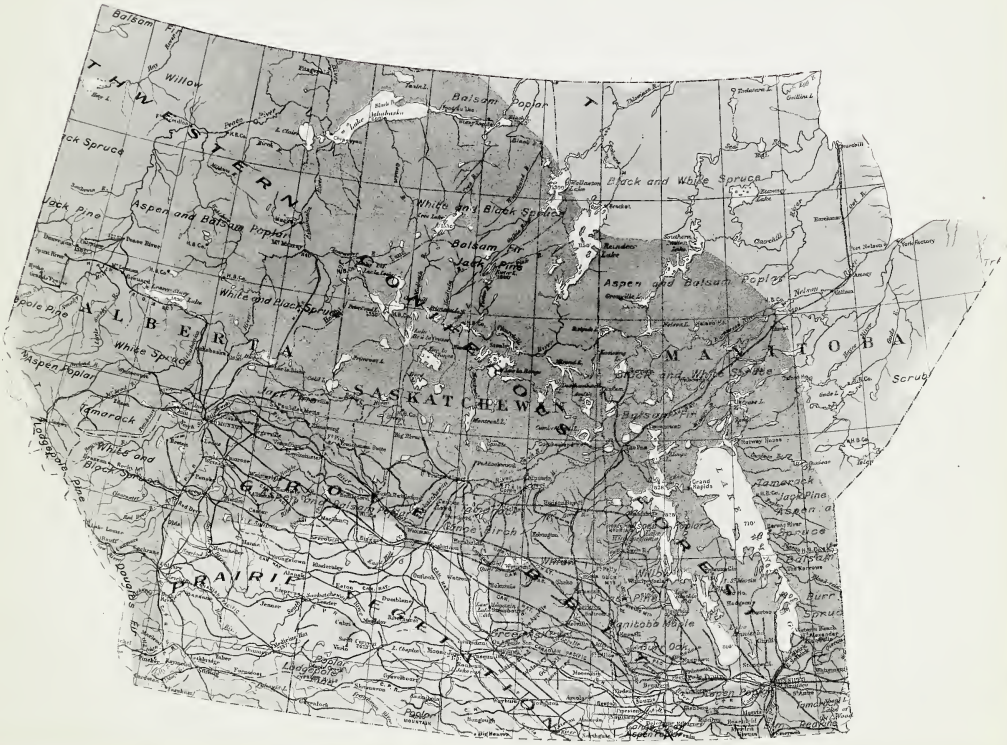

Fig. 1.

Vegetation Zones of the
Prairie Provinces.

* Photo of Map - Dept. of Interior Canada 1930.

The three main vegetation zones are: (a) northern coniferous forest; (b) deciduous forest; and, (c) prairie. The deciduous forest is not well defined. The northern coniferous forest extends into the deciduous forest and this, in turn, into the prairie, especially along rivers and stream valleys.

There are two types of deciduous forest. The first, or oak, divides the deciduous forest of the east from the true prairie. The second, or poplar, stands between the northern coniferous forest and the true prairie. The deciduous forest area extends from the 49th parallel in Manitoba in a curved line, first towards the northwest, through Saskatoon to Stettler, and then south along the foothills. ~~A parkland area or aspen consociation between prairie and deciduous forest extends into the prairie~~. The deciduous forest varies in width from 25 to 150 miles and is generally considered as a climax community. Moss (57). Bird (8) has divided the poplar community into three parts: (a) prairie community; (b) willow community; and (c) aspen community.

Wild fruits are found mostly in the deciduous forest, in the park very dark brown soil area; in the transition timber and park soil area, and, to a more limited extent, in the prairie plain dark brown soil area. Scattered clumps of fruiting shrubs also are found in the draws and coulees of the plains brown soil. The Cypress Hills, an unglaciated area, and the Qu'Appelle Valley, located in the plains brown soil area have numerous wild fruits. (Fig. 2*)

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*Reprint from Stevens, Hurd and Grindley (75).

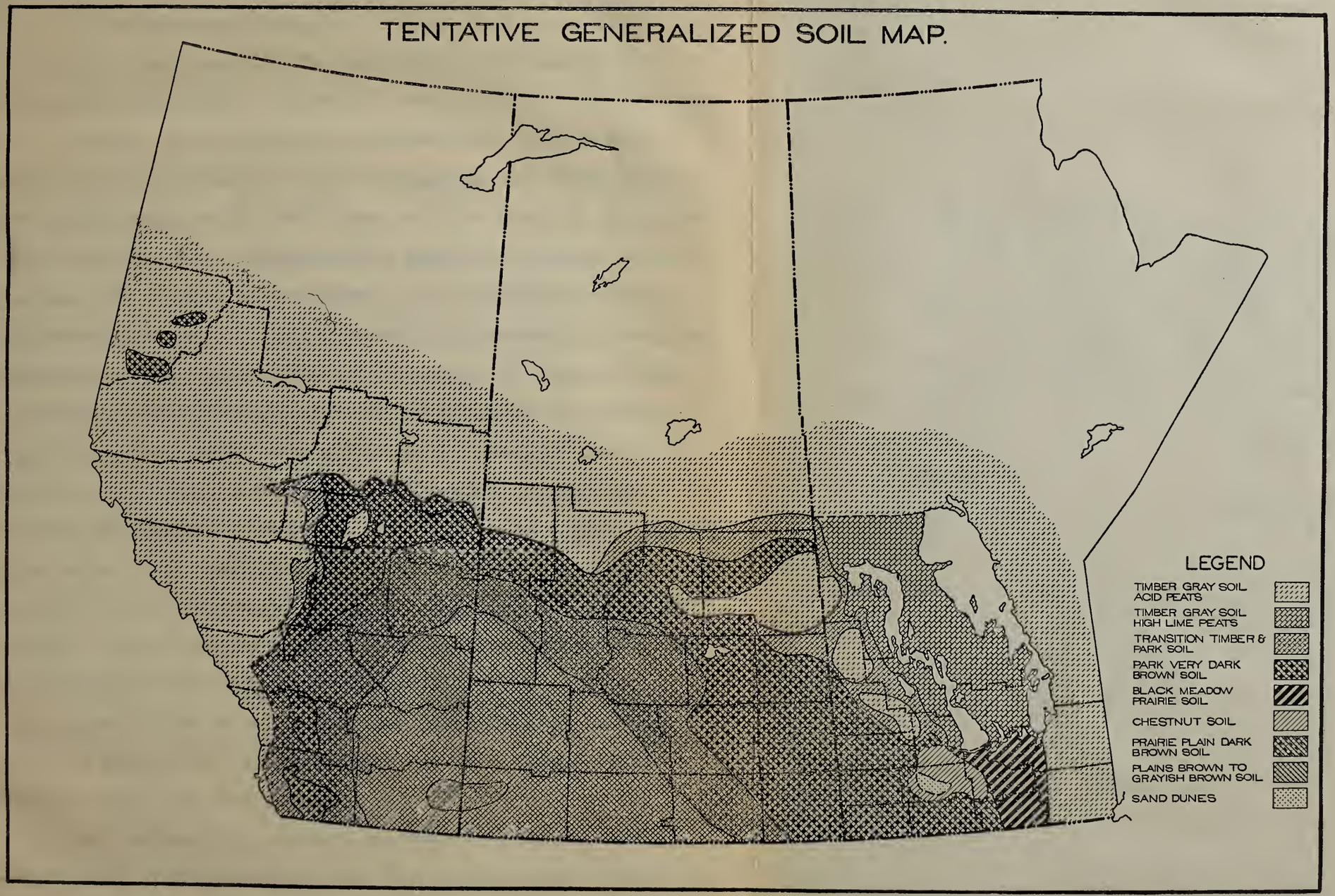
TENTATIVE GENERALIZED SOIL MAP.
LEGEND
TIMBER GRAY SOIL ACID PEATS
TIMBER GRAY SOIL HIGH LIME PEATS
TRANSITION TIMBER & PARK SOIL
PARK VERY DARK BROWN SOIL
BLACK MEADOW PRAIRIE SOIL
CHESTNUT SOIL
PRAIRIE PLAIN DARK BROWN SOIL
PLAINS BROWN TO GRAYISH BROWN SOIL
SAND DUNES

Fig. 2.

Rainfall.-

Rainfall of the prairie provinces is discussed by Stevens, Hurd and Grindley (75), as follows:

"In southeastern Alberta, a large part of western Saskatchewan, and generally in the northern regions of the three prairie provinces, the annual precipitation averages less than 15 inches. In a portion of southeastern Alberta and southwestern Saskatchewan, where the winters are fairly mild, where spring comes early, fall late, and the heat of the summer is often intense, the average annual amount is between 10 and 12 inches. In eastern Saskatchewan, from the Touchwood Hills southeasterly to Moose Mountain creek, and generally throughout southern Manitoba, the annual amount exceeds 15 inches, while in a portion of the Red River Valley in Manitoba it exceeds 20 inches. In a narrow strip close to the Rocky Mountains in southwestern Alberta, in the upper valleys of the Red Deer River and its western tributaries, as well as in a large portion of the basin of the North Saskatchewan River in Alberta, and in the basin of the Athabasca river, 15 inches is also generally exceeded. In the extreme southwestern portion of Alberta, the annual amount averages 20 to 30 inches."

About 60 to 70 percent of the precipitation is from April 1 to August 31. Approximately one-half of the total occurs in June, July and August.

The northern and western portions of Alberta, the northern part of Saskatchewan, and the greater part of Manitoba are covered with snow during the winter months. They suffer less from lack of moisture than the southern prairie portions

which frequently are free from snow covering during the greater part of the winter.

Temperature.-

Temperatures vary widely and suddenly in the prairie provinces. This in itself is a serious problem in horticultural development of hardy fruits. It is possibly equally as significant as low temperature readings.

Temperatures of -20° to -30° F. are common and -60° to -70° F. have been recorded in the northern parts. In Alberta, temperatures of 60° to 75° F. are possible in mid-winter. The marked fluctuations in winter are limiting factors in the adaptability of fruit plants. The ~~reactions~~ fluctuations in temperature, however, are less severe as one passes from west to east and from south to north. The high temperatures in the south are frequently accompanied by warm, dry, Chinook winds. Alberta has, generally, the mildest winter of the prairie provinces followed in order by Saskatchewan and Manitoba (Fig. 3*).

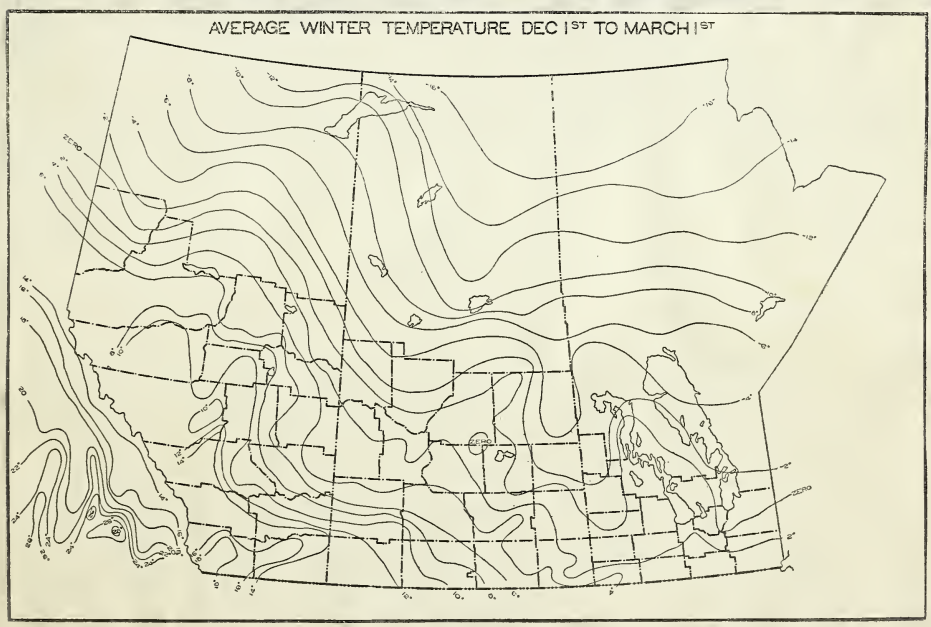

Fig. 3

*Reprint from Stevens, Hurd and Grindley (75).

April is considered the first spring month with an average temperature of 55° F. at midday. Cold waves may occur during this time to lower the temperature to -5° F. It is during this period that the wood, fruit buds and leaf buds, having completed their rest period, are the most susceptible to injury. (Fig. 4*)

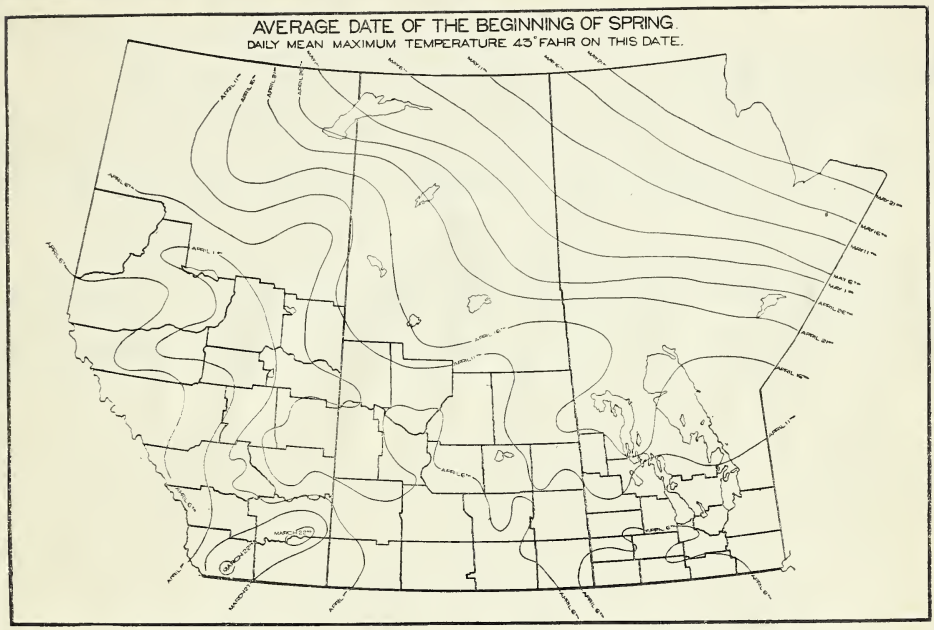

Fig. 4.

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* Reprint from Stevens, Hurd and Grindley (75.

During summer, the western half of Alberta has almost a similar temperature from north to south. The northern parts, of the balance of the prairie provinces, are on the average the same as western Alberta but the southern parts have higher temperatures. The agricultural area of the Peace River averages a 30 day shorter growing season than that of southeastern Alberta, Saskatchewan and Manitoba. (Fig. 5*)

Under the above conditions it is considered practically impossible to acclimatize cultivated varieties from regions with a milder and more equable climate. Development of improved sorts will undoubtedly require that at least one parent contribute hardiness. It is hoped that this work will serve to provide information and material of value for future work and breeding.

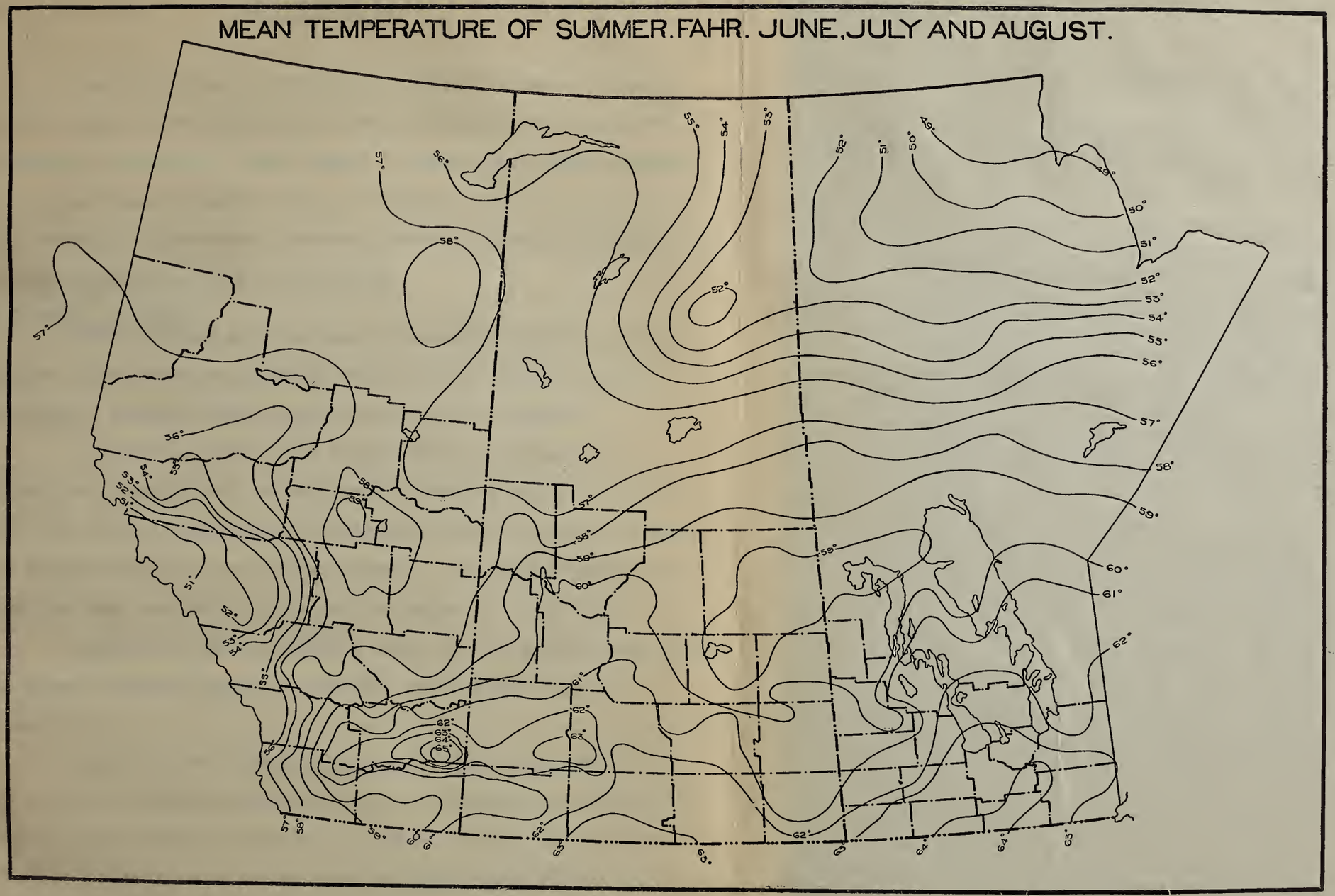

Fig. 5.

LITERATURE REVIEW

Our knowledge of the prairie flora is based largely on the work of the Geological Survey of Canada and of a few botanical collectors. Some areas are well described, whereas others have been treated only in a general way. A review of the available literature, however, helps to give a picture of the distribution of the wild fruits.

Geological Surveys.-

The earliest information of technical nature on the prairie flora is that given in the reports of the Canadian Geological Survey, then directed by A. R. C. Selwyn.

In 1875 and 1876 John Macoun (51) accompanied Selwyn on a geological journey which covered the territory from the Peace River across the northern part of the prairies via Edmonton to east of Prince Albert. The fruits noted as found in the district are listed in Table I, Column 15.

McConnell (54) reported a list of the raspberries found in 1879-80 between Edmonton and the Peace River (Table I, Column 4).

Bell (7), in 1879-80, mentioned the fruits found in the territory which he covered. This represented the country north of Peace River, from Peace River to Edmonton and that drained by the rivers to the west of Hudson Bay (Table I, Column 5). He gave the range of Prunus americana Marshall as the Rainy River, the Red River, the lower part of the Assiniboine River and the southern end of Lake Manitoba.

Prunus pennsylvanica was described as being "widely distributed, extending nearly to the edge of the timber". In his (6) report of 1881, he also included notes on the flora of the Lake of the Woods and adjacent country (Table I, Column 6).

Dawson (25), in 1887-88, described the country in the northern part of Alberta, the Yukon, and Northwest Territories and reported the northern range of Amelanchier alnifolia as parallel 58. His list includes the fruits (Table I, Column 7).

Reports of Botanists.-

Lewis, Dowding, and Moss (46); Dowding (28); and Moss (57), in 1928-32 studied the vegetation of central Alberta and described a number of communities which occurred in the parkland. The fruits mentioned are tabulated in Table I, Columns 9, 10, and 11.

Raup's (60,61) flora of the Peace River district, the northern part of Alberta, the southern part of the North West-territories and of Wood Buffalo Park describes and lists the fruits of the territory (Table I, Columns 3 and 8).

Rydberg (66,67) described many of the species which occur in the west (Table I, Columns 1 and 2).

Climate was found by Turresson (76, 77, 78) to influence a species and divide it into ecotypes. This conclusion was drawn after working with transplanted material and from plants raised from seed gathered in different climatic areas. He found that earliness increased and height decreased from south to north. The biotypes of the species in one region were shown to be genetically different from those in another.

Table I. Fruit Species Mentioned In Reports On The Flora Of The Prairie Provinces*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15.
Corylus															
americana	x											x	x		x
cornuta			x								x		x		x
Grossularia															
cynosbati	x														
setosa	x	x					x				x		x		
inermis	x	x													
hirtella	x														x
oxyacanthoides			x					x							x
Ribes															
americanum	x	x									x				
petiolare		x													
laxiflorum		x													
hudsonianum			x				x	x	x		x		x		x
glandulosum			x								x				x
triste			x				x	x			x				x
Chrysobotrya															
aurea													x		
Limnobotrya															
parvulu		x													
lacustris			x					x			x				x
Fragaria															
americana	x	x	x					x		x			x		
canadensis	x														
pauciflora	x	x													
glauca			x					x							
virginiana							x					x	x		x
vesca															x

Table I continued.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rubus															
arcticus	x		x	x			x		x				x		x
melanolasius	x														
pedatus		x		x											
idaeus L. var. strigosus			x					x							
chamaemorus			x	x				x	x				x		x
pubescens			x					x	x		x				x
acaulis			x					x							
subarcticus								x							
strigosus									x		x		x		x
idaeus aculeatissimus												x			
nutkanus													x		x
grandiflorus													x		
Amelanchier															
canadensis	x	x													x
humilis	x	x													
alnifolia	x	x					x			x	x		x		x
florida		x	x					x							
oblongifolia												x			
Sorbus															
americana	x												x		x
scopulina	x		x										x		x
sitchensis			x												
Crataegus															
succulinta	x	x													
chrysocarpa	x	x													
coccinea		x											x		x
douglasii		x											x		

Table I continued.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Prunus															
nigra	x														
americana					x								x		x
pumila	x												x		x
melanocarpa	x	x							x	x					
Besseyi		x												x	
demissa			x												
pennsylvanica			x		x			x		x			x		x
virginiana							x					x	x		x
Vitis															
vulpina	x												x		
cordifolia													x		x
Shepherdia															
argentea	x												x		x
canadensis		x	x				x	x	x	x	x		x		x
Gaylussacia															
baccata	x														
Vaccinium															
oreophilum		x													
uliginosum	x		x												
caespitosum			x			x					x		x		x
scoparium	x	x													
membranaceum			x												
Cyanococcus															
canadensis	x	x	x						x	x	x		x		x
pennsylvanicus	x	x											x		
angustifolius	x														
Vitis-Idaea															
punctata	x	x	x					x	x	x	x				x

Table I continued.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Oxycoccus															
microcarpus	x														
macrocarpus	x	x											x		
palustris			x					x	x				x		x
Sambucus															
canadensis	x												x		x
pubens			x										x		x
melanocarpa													x		
Viburnum															
eradiatum			x			x	x	x	x		x		x		x
trilobum										x	x	x	x		x
Lonicera															
villosa			x												
Xylosteon															
caeruleum						x							x		x

* 1 - Rydberg (67); 2 - Rydberg (66); 3 - Raup (60); 4- McConnell (54); 5 - Bell (7); 6 - Bell (6); 7 - Dawson (25); 8 - Raup (61); 9 - Lewis, Dowding, and Moss (46); 10 - Dowding (28); 11 - Moss (57); 12 - Bird (8); 13 - Macoun (52); 14 - Adams (58); 15 - Macoun (51).

Questions of Classification and Synonyms.-

A survey of the literature on the flora of the prairies leads to the conclusion that many of the species are not clearly defined or the variations known. Is Amelanchier alnifolia of all reports the same? Can we be certain that Prunus melanocarpa, P. demissa, and P. virginiana are all present in the same range or that Lonicera villosa and Xylosteon caeruleum are not the same under different environments? The American Cranberry bush (Viburnum opulus americanum Ait. or V. trilobum Marsh and V. americanum as described by Darrow (19) is (or are) widely distributed on the prairie. Are these terms synonymous with one another and with the V. opulus of Europe? Darrow (19) segregated them according to fruit characteristics - the latter is described as bitter, and the former as clear and acid.

Rozonova (65) in an investigation into geographical and ecological variation found that spinosity and glandulosity varied. She believed this variation to be geographical and ecological. This being the case, are Rubus strigosus and R. melanolasius ecotypes rather than distinct species?

Another problem presents itself in the Vacciniaceae. Oxycoccus palustris Pers. and O. macrocarpus (Ait.) Pers., two species which are easily set aside, have O. microcarpus Turcz as an intermediate type? The question is whether the latter is a hybrid or a marked variation in one or the other parent due to varying combinations of characters. Sinskaia and Stchenkova (73) working with Vaccinium uglinosum L. and V. myrtillus L. as well as with V. vitis-idaea found that there was no sharp difference between characters of ecotypes and concluded that

Possibilities of Diversification and Innovation.-

the wide variation must be due to genetic differences segregating and recombining. The difficulty encountered was that their material was not grown under controlled conditions due to the difficulties in propagation.

The late D. W.Buchanan (9), in 1907, wrote as follows:

"The European gooseberry and plum, both of which are now represented by numerous varieties of unsurpassed excellence, are said to be inferior in their original wild form to our native species. With this knowledge before us, there would seem to be no reason why some species at least of our wild fruits should not form the basis from which many fine cultivated varieties will in time be evolved. To talk of our provinces as a fruitless region in view of the existence of all these native species, seems ridiculous."

Buchanan realized the value of the native plum and made reference to the selection work that had been done on it up to that time and the introduction of seedlings of it from the United States.

Since that time, the plum has received great attention, as also have the sand cherries Prunus besseyi and P. pumila. The late George F. Chipman (11) has done much to make these and other fruits increasingly popular in western Canada. He realized the lack of any literature pertaining to fruit growing in the west. With his wide contacts he possibly had more knowledge of the horticultural work in the prairie provinces than any other one person and with this experience he made the following statement:

"I feel today that the delusion under which we have always labored -- that because of our climate we are forever prohibited from growing worth-while fruit, is completely dispelled."

Discussing the native fruits of the west Chipman points out that no work has been done with the native hazelnut, the high-bush cranberry, or the wild pincherry, which he felt had possibilities.

Rydberg's (67) classification has been used throughout the text, except as otherwise noted. A number of the species reported in the literature have a number of synonyms. These are listed in Table II.

Table II. Synonyms of Fruit Species.

Corylus americana Walt.....	C. calyculata Dipp.
C. cornuta Marsh.....	C. rostrata Ait.
Grossularia cynosbati (L.) Mill	Ribes cynosbati L.
	R. gracile Michx.
G. setosa (Lindl) Cov. and Britt.....	R. setosum Lindl.
	R. saximontanum E. Nels.
G. inermis (Rydb.) Cov.&Britt.	
G. cynosbati (L.) Mill.....	R. cynosbati L.
	R. gracile Michx.
G. setosa (Lindl) Cov. and Britt.	R. setosum Lindl.
	R. saximontanum E. Nels.
G. inermis (Rydb.) Cov. and Britt	R. inerme Rydb.
	R. vallicola Greene.
G. hirtella (Michx.) Spach.	R. hirtellum Michx.
G. oxyacanthoides (L.) Mill.....	R. oxyacanthoides L.
Ribes americanum Mill	R. floridum
R. petiolare Dougl*	
R. hudsonianum Richards	
R. glandulosum Weber.....	R. prostratum L'Her
R. triste Pall	R. albinervium Michx.
	R. rubrum A. Gray.
Chrysobotrya aurea (Pursh) Rydb.....	Ribes aureum Pursh.
	Chrysobotrya lindleyana Spach.
	C. intermedia Spach.
Limnobotrya parvulu*	
L. lacustris (Pers) Rydb.....	Ribes lacustre (Pers.) Poir
Fragaria americana (Porter) Britton	F. vesca americana Porter.
F. canadensis Michx.	
F. pauciflora Rydb.	
F. glauca (S. Wats) Rydb.....	F. virginiana glauca S. Wats.
F. virginiana Duchesne ...	
Rubus articus L.	
R. melanolasius Focke	R. strigosus of western report.
	Batidaea laetissima. Greene.
	B. dacotica Greene.
	B. unicolor Greene.
	B. sandbergii Greene.

* Not according to Rydberg

Table II continued.

R. pedatus Smith*	
R. idaeus L. var strigosus (Michx.) Max*	
R. chamaemorus L.	
R. pubescens Raf.....	R. triflorus Richardson.
	R. americanus (Pers.) Britt.
R. acaulis Michx.	
R. Idaeus acuteatissims*	
R. grandiflorus*	
Rubacer parviflorum (Nutt) Rydb.....	Rubus nutkanus Moc.
	R. parviflorum Nutt.
	Bossekia parviflora Greene.
Amelanchier canadensis (L.) Medic.....	A. canadensis botryapium (L.) T. and G.
	A. botryapium D. C.
A. humilis Wrig.	
A. alnifolia Nutt.	
A. florida Lindl*.....	A. elliptica A. Nels.
A. oblongifolia (T. and G.) M. Roemer.....	A. spicata (Lam.) D. C.
Sorbus americana Marsh	Pyrus americana D. C.
S. scopulina Greene	Pirus sambucifolia Porter.
S. Subvestita Greene.....	S. sambucifolia Britt.
	Pyrus sitchensis Robins and Fern.
	S. decora (Sargent) C. K. Schneider.
	S. scopulina Britton.
Crateagus succulinta Schrad.....	C. macracantha (Lindl) Lodd
	C. occidentalis Britton.
	C. coloradensis A. Nels.
	C. coloradoides Ramaley.
	C. colorado Ashe.
C. chrysocarpa Ashe.....	C. rotundifolia (Ehrh) Borckh.
	C. doddsii Ramaley.
	C. sheridana A. Nels.
C. coccinea*.....	possible C. coccinoides Ashe (see Rydb. 443)
C. Douglasii Lindl.....	C. brevispina (Dougl.) Farwell.
Prunus Nigra Ait	
P. americana Marsh	
P. pumila L.	
P. Besseyi Bailey.....	P. prunella Daniels.
P. melanocarpa (A. Nels) Rybd.....	Cerasus demissa melanocarpa A. Nels.
P. demissa (Nutt) Walp.....	Cerasus demissa Nutt.
P. pennsylvanica L.	

Table II continued.

Prunus virginia L.	Padus serotina Agardh. P. serotina (Agardh) Ehrh.
Vitis vulpina L.	
V. cordifolia Michx.	
Shepherdia argentea Nutt.	Lepargyrea argentea (Nutt) Greene.
S. canadensis (L.) Nutt.	L. canadensis (L.) Greene.
Gaylussacia baccata (Wangenh) C. Koch.	G. resinosa.
Vaccinium oreophilum Rydb.	V. myrtillus Hook
V. uliginosum L.	
V. caespitosum Michx.	
V. scoparium Leiberg.	V. erythrococcum Rydb.
V. membranaceum Dougl.	V. myrtilloides Hook.
Cyanococcus canadensis (Richards) Rydb.	Vaccinium canadensa Richards.
C. pennsylvanicum (Lam) Rydb.	V. pennsylvanicum Lam.
C. angustifolius (Ait) Rydb.	V. angustifolium Ait. V. pennsulvanicum angustifolium A. Gray. V. fissum Schrank.
Vitis-Idaea punctata Moench.	Vaccinum Vitis-Idaea L. Vitis-Idaea Vitis-Idaea (L.) Britton.
Oxycoccus palustris pers.	Vaccinium oxycoccus L. Oxycoccus oxycoccus MacMill.
O. microcarpus Turcz.	Vaccinium microcarpum (Turcz) Hook.
O. macrocarpus (Ait) Pers.	
Sambucus pubens Michx.	S. racemosa Hook.
S. canadensis L.	
S. Melanocarpa*	
Viburnum eradiatum (Oakes) House.	V. pauciflorum Pylaie
V. trilobum Marsh.	V. opulus americanum Ait.
Lonicera villosa*	
Xylosteon aeruleum (L.) Dum. Cours.	Lonicera caerulea L.

Material and Methods

In order to make the collection as wide in its representation as possible various means of securing specimens were practised, such as: (a) correspondence with interested persons, and (b) personal trips. So far as possible, the personal knowledge of the type of country from which the material came was desired. Funds available made this possible for certain southern parts of Alberta where the author lacked personal observation. The northern part of the province was not visited because, although funds were available for this purpose, wet conditions during the times of year suitable for collection made a trip there impossible.

Many contacts were made by personal correspondence. Without the aid of friends and parties interested in horticultural progress the collection would not have reached its present proportions.

The specimens were collected during the spring and fall of 1934 and the spring of 1935. The work did not start until late in the spring of 1934. By that time the plants had leafed out, so the material collected was planted immediately it was received; hence, no attempt was made at that time to save cytological material.

The fact should be borne in mind that in collecting the individuals of a species from a certain location, it is the exceptional plant, in most cases, that has been taken.

The plants received in the fall of 1934 were heeled-in over winter and, along with the collections of the spring of 1935, were potted. The pots were plunged to the rim in soil and carefully watered. When the desired root material had been gathered for cytological study the potted plants were removed to the orchard and planted permanently.

In the fall of 1934 and the fall of 1935 seed collections were also made. Owing to the greater ease of obtaining these, the lower cost of transportation, and the possibilities of selection, a large part of the collection was obtained in this way.

As soon as the seed was received it was washed clean and stored. Its further treatment will be discussed in the section on propagation. After germination, the seedlings were pricked-out into thumb pots, and then into $2\frac{1}{2}$" pots in which they were wintered in a root cellar. Early in January 1936 they were moved to the greenhouse so that cytological material could be taken before planting out in the orchard in the spring.

Both of these methods immediately limited, temporarily, the scope of the intended work. The problems of vegetative propagation and of seed germination had first to be dealt with and solved. The working out of this has taken a great deal of time and in turn has delayed identification. Successful transplanting of the fruit trees necessitated severe pruning and often cutting back to ground level. The resultant growth has not yet, in a large percentage of the cases, been sufficient for identification. Seedlings obtained from seed gathered in

the fall of 1934 do not yet average 3 inches in height, and seed collected in the fall of 1935 is just commencing to germinate.

As the material was gathered and planted it was systematically labelled so that each plant could be readily identified as to its genera, place of origin, and the group with which it was gathered. The label numbers indicate the type of material, number of collection, number of plant in collection. When there are four numbers, the third number refers to a seed collection and the fourth to a number originating from one of the seeds. For example, 1-6-1 identifies a Saskatoon, the sixth collection made, and the first plant in that collection. Furthermore, 2-8-1-3 identifies a seedling Chokecherry, the eighth collection, the first group of seed in this collection, and the third seedling.

Where shading, as in the Vacciniaceae, was necessary, special precautions were taken in this respect.

Each genus was planted in the horticultural area at the University of Alberta in a section generously set aside for this purpose by Mr. George Harcourt (who has since retired). The genera and species, where possible, were segregated and planted in rows 6 feet apart and 2 feet apart in the row. This spacing eventually will allow them to be carefully compared one with another.

From time to time, as the plants have come into bloom, material has been pressed and species of the flowers preserved for identification purposes.

Amount and Sources of Collections.

The transplanting and seed collecting which was started in the spring of 1934 is now represented by 580 specimens from 178 collections. The collections represent widely different climatic and edaphic conditions. A large portion of Alberta is represented. Material from the balance of the prairies is representative but from widely scattered locations.

Prairie Province districts from which collections have been obtained are: Alberta - Cypress Hills, Medicine Hat, Coleman, McLeod, Brooks, Carseland, Calgary, Midnapore, Banff, Windermere, Irricana, Howie, Morrin, Lacombe, Rocky Mountain House, Provost, Vegreville, Tofield, Hastings Lake, Edmonton, Fallis, Drayton Valley, Evansburg, MacKay, Edson, Obed, Clyde, Athabasca, Peace River, and Slave Lake; Saskatchewan - North Battleford, Saskatoon, and Maple Creek; Manitoba - Dropmore and Brandon.

The details of each collection can be found in Table III. The species name when known is given. No positive identification has been made and all are thus in a temporary state. It will be, on an average, two years before this can be accomplished. The origin, collector, type of material collected, and the date collected are also given. A few of the collections, due to adverse conditions, did not survive.

Names and Synonyms of Collembola.

Table III. Record of Collections.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
1-1-1 to 1-1-13	Amelanchier sp.	Provost	Farquharson	S.34	Rts.	1-2-3-4-5 are in hazel row. Flowered June 1st.
1-2-1 to 1-2-5	do	Fallis	Hargrave	S.34	Rts.	
1-3-1 to 1-3-2	do	Morrin	Rocke	S.34	Rts.	
1-4-1 to 1-4-3	do	Drayton Valley	Wilson	S.34	Rts.	
1-5-1 to 1-5-3	do	Brandon Exp. Stn.		S.34	Rts.	
1-6-1 to 1-6-26	do	Dropmore	Skinner	S.34	Rts.	Selected seedlings.
1-7-1 to 1-7-3	do	Howie	Hannaford	S.34	Rts.	
1-8-1 to 1-8-3	do	Lacombe	Bolten	S.34	Rts.	
1-10-1* to 1-10-6	do	Brocks	Griffin	F.34	Rts.	Exceptional plant.
1-11-1* to 1-11-6	do	Brocks	Griffin	F.34	Rts.	White
1-12-1	do	Granada	Hargrave	F.34	Sds.	Failed to germinate.
1-13-1	do	Lacombe	Bolten	F.34	Sds.	Failed to germinate.
1-14-1	do	Evansburg	Hargrave	F.34	Sds.	Failed to germinate.

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks
1-15-1	Amelanchier sp.	Edmonton	Hargrave	F.34	Sds.	Failed to germinate.
1-16-1	do	Irricana	McCune	F.34	Sds.	do.
1-17-1	do	Islay	McCoombe	F.34	Sds.	do. Seed from white plant.
1-18-1	do	Hasting's Lake	Hargrave	F.34	Sds.	
1-19-1 to 1-19-4	do	McLeod	Sander	F.34	Rts.	
1-20-1* to 1-20-7	do	Carseland	Moorhouse	F.34	Rts.	
1-21-1	do	Brooks		S.35	Rts.	Originally from Red Deer River Valley, near Red Deer.
Budded stock	do	Brooks	Hargrave	Sum. 34.	Buds	Buds from white Saskatoon.
Budded stock	do	Lake Saskatoon	Wilson	Sum. 35	Buds	Buds from best stock in north.
Seedlings	do	Brooks	Hargrave	F.35	Seeds	Seed from parent of 1-10-1
2-1-1 to 2-1-11	P. Melanocarpa	Provost	Farquharson	S.34	Rts.	
2-2-1 to 2-2-4	do	Fallis	Hargrave	S.34	Rts.	
2-3-1 to 2-3-3	do	Brandon Exp. Stn.		S.34	Rts.	

Table 171 continued.

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
2-4-1	P. Melanocarpa	Howie	Hannaford	S.34	Rts.	
2-5-1	do	Midnapore	Ockley	F.34	Rts.	
2-6-1*	do	Brooks	Griffin	F.34	Rts.	
2-7-1	do	Saskatoon	Patterson	F.34	Rts.	Yellow fruit.
2-8-1-1 to 2-8-1-10	do	Edmonton	Hargrave	F.34	Sds.	
2-9-1-1 to 2-9-1-9	do	Edmonton	Hargrave	F.34	Sds.	
2-10-1	do	Edmonton	Hargrave	F.34	Sds.	
2-11-1-1* to 2-11-1-10	do	Evansburg	Hargrave	F.34	Sds.	
2-12-1-1 to 2-12-1-10	do	Edmonton	Hargrave	F.34	Sds.	
2-13-1-1 to 2-13-1-10	do	Edmonton	Hargrave	F.34	Sds.	
2-14-1	do	Galloway	Hargrave	F.34	Sds.	Failed to germinate.
2-15-1	do	Lacombe	Bolton	F.34	Sds.	
2-16-1-1 to 2-16-1-2	do	Edmonton	Hargrave	F.34	Sds.	
2-17-1	do	Edmonton	Hargrave	F.34	Sds.	Old orchard.
2-18-1-1 to 2-18-1-9	do	Edmonton	Hargrave	F.34	Sds.	
2-19-1	do	Brooks	Hargrave	F.34	Sds.	Failed to germinate.

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
2-20-1-1 to 2-20-1-5	P. Melanocarpa	Maple Creek	Hillerud	F.34	Sds.	
2-21-1	do	Tofield	Hargrave	F.34	Sds.	Failed to germinate.
2-22-1 to 2-23-1	do	Edmonton	Hargrave	F.34	Sds.	
2-24-1* to 2-24-5	do	Dropmore	Skinner	S.35	Rts.	
2-25-1* to 2-25-7	do	McLeod	Sander	F.34	Rts.	
3-1-1 to 3-1-5	P. Pennsylvanica	Fallis	Hargrave	S.34	Rts.	Specimen collected. Flowered June 4.
3-2-1	do	Edmonton	Hargrave	S.34	Rts.	Specimen collected. Flowered June 5.
3-3-1 to 3-3-3	do	Brandon Exp. Stn.		S.34	Rts.	Specimen collected. Flowered June 10.
3-4-1 to 3-4-5	do	Dropmore	Skinner	S.34	Rts.	
3-5-1 to 3-5-3	do	Lacombe	Bolten	S.34	Rts.	
3-6-1* to 3-6-11	do	Brooks	Griffin	F.34	Rts.	
3-7-1-1 to 3-7-1-5	do	Edmonton	Hargrave	F.34	Sds.	From tall plant with black fruit.

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
3-8-1-1 to 3-8-1-2	P. Pennsylvanica	Edmonton	Hargrave	F.34	Sds.	
3-9-1	do	Edmonton	Hargrave	F.34	Sds.	Failed to germinate.
3-10-1	do	Evansburg	Hargrave	F.34	Sds.	Failed to germinate.
3-11-1	do	Edmonton	Tufford	F.34	Sds.	Failed to germinate.
3-12-1-1* to 3-12-1-5	do	Lacombe	Bolten	F.34	Sds.	
3-13-1-1	do	Hasting's Lake	Hargrave	F.34	Sds.	
3-14-1-1 to 3-14-1-5	do	Brooks	Hargrave	F.34	Sds.	
3-15-1	P. Pumila	The Pas		Collected previously.		A sample of the furthest north Sand Cherry.
4-1-1 to 4-1-3	V.Trilobum	Dropmore	Skinner	S.34	Rts.	Selected seedlings.
4-2-1	do	Edmonton	Hargrave	S.34	Rts.	
4-3-1 to 4-3-5	do	Lacombe	Bolten	S.34	Rts.	
4-4-1	do	Midnapore	Ockley	F.34	Rts.	
4-5-1 to 4-5-2	do Sterillis	Brooks	Griffin	F.34	Rts.	Snow Ball
4-6-1	V. Trilobum	Edmonton	Hargrave	F.34	Rts.	

Table 111 continued.

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
4-7-1	V. Trilobum	Tofield	Hargrave	F.34	Cutgs.	Dead
4-8-1	do	Edmonton	Hargrave	F.34	Sds.	Failed to germinate.
4-9-1	do	Brooks	Hargrave	F.34	Sds.	Failed to germinate.
4-10-1 to 4-15-1	do	-	Chipman	F.34	Sds.	
4-13-1-1 to 4-13-1-5	do	-	Chipman	F.34	Sds.	
5-1-1 to 5-1-9	V. Eradiatum	Fallis	Hargrave	S.34	Rts.	
5-2-1	do	Midnapore	Ockley	F.34	Rts.	
5-4-1	do	Edmonton	Hargrave	F.34	Sds.	Failed to germinate.
5-5-1	do	Edmonton	Hargrave	F.34	Sds.	Failed to germinate.
5-6-1	do	Lacombe	Bolten	F.34	Sds.	Failed to germinate.
5-7-1-1 to 5-7-1-6	do	Hasting's Lake	Hargrave	F.34	Sds.	
6-1-1 to 6-1-4	C. Cornuta	Fallis	Hargrave	S.34	Rts.	
6-2-1 to 6-2-7	do	Edmonton	Hargrave	S.34	Rts.	
6-3-1 to 6-3-8	Corylus sp.	Brandon Exp. Stn.		S.34	Rts.	

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered.	Type of Matl.	Remarks.
6-4-1 to 6-4-3	Corylus sp.	Dropmore	Skinner	S.34	Rts.	
6-5-1	C. Cornuta	Lacombe	Bolten	S.34	Rts.	
6-6-1* to 6-6-13	C. Americana	Brooks	Griffin	S.35	Rts.	Originally from Manitoba. Exceptional plants.
6-7-1-1 to 6-7-1-7	C. Cornuta	Winnipeg	Chipman	F.34	Rts.	A sample from a collection gathered over the west.
6-7-1* to 6-7-2	C. Americana	Brooks	Griffin	S.35	Sds.	
6-8-1* to 6-8-4	do	Dropmore	Skinner	S.34	Rts.	
7-1-1 to 7-1-5	R. Americanum	Big Lake	Hargrave	S.34	Rts.	Specimen collected. Flowered June 8, 1935. Mildew.
7-2-1 to 7-2-2	do	Brandon Exp. Stn.		S.34	Rts.	Sprawly.
7-3-1 to 7-3-3	do	Howie	Hannaford	S.34	Rts.	Strong, Healthy, Best.
7-4-1	do	Edmonton	Hargrave	S.34	Rts.	Mildew.
7-5-1	Ribes sp.	Ft. Simpson	Robin	S.34	Rts.	
7-6-1	R. Americanum	Lacombe	Bolten	S.34	Rts.	Specimen collected. Flowered June 10.
7-7-1 to 7-7-3	R. Hudsonianum	Colinton	Clark	S.34	Rts.	

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
7-9-1 to 7-9-3	R. americanum	Mirror	Rocke	S.34	Rts.	June 6,1935.
7-10-1 to 7-10-4	do	Edmonton	Hargrave	S.34	Ctgs.	From cultivated plant on White Avenue.
7-11-1* to 7-10-4	do	Edmonton	Hargrave	S.34	Rts.	
7-12-1	Ribes sp.	Midnapore	Ockley	F.34	Rts.	
7-13-1* to 7-13-8	R. americanum	Brooks	Griffin	F.34	Rts.	
7-14-1-1 to 7-14-1-9	Ribes sp.	Lacombe	Bolten	F.34	Sds.	
7-15-1-1* to 7-15-1-10	R. americanum	Edmonton	Hargrave	F.34	Sds.	From heavy producing upright plants.
7-16-1*	do	Dropmore	Skinner	S.35	Rts.	
7-17-1* to 7-17-3	R. factidium	Dropmore	Skinner	S.35	Rts.	
7-18-1	R. americanum	Edmonton	Harcourt			Two plants previously in orchard. Of good quality.
7-18-2	do	Edmonton	Harcourt			
7-19-1	R. sp.	Cypress Hills	Bolten	F.35	Sds.	
	R. sp.	Coutts	Rocke	F.35	Ctgs.	Exceptionally well flavored fruit of large size.
8-1-1 to 8-1-3	Ribes	Big Lake	Hargrave	S.34	Rts.	Specimen collected. Flowered May 28. Seems self sterile.

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
8-2-1 to 8-2-2	Ribes	Lacombe	Bolten	S.34	Rts.	
8-3-1	Ribes	Midnapore	Ockley	F.34	Rts.	
8-4-1	Ribes	Lacombe	Bolten	F.34	Sds.	Failed to germinate.
8-5-1* to 8-5-4	R. americanum	Dropmore	Skinner	S.35	Rts.	
8-6-1*	do	McLeod	Sandon	F.34	Rts.	
9-1-1	Sombus sp.	Obed	Hargrave	F.34	Sds.	
9-2-1	do	Brooks	Hargrave	F.34	Sds.	
10-1-1 to 10-1-8	Rubus sp.	Carrot Creek	Hargrave	F.34	Rts.	
10-2-1 to 10-2-3	do	Fallis	Hargrave	S.34	Rts.	
10-3-1 to 10-3-2	do	Morrin	Rocke	S.34	Rts.	
10-4-1 to 10-4-4	do	Big Lake	Hargrave	S.34	Rts.	
10-5-1 to 10-5-3	do	Brandon Exp. Stn.		S.34	Rts.	
10-6-1 to 10-6-2	do	Howie	Hannaford	S.34	Rts.	
10-7-1	do	Fort Simpson	Robin	S.34	Rts.	
10-8-1 to 10-8-3	do	Lacombe	Bolten	S.34	Rts.	

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
10-9-1	Rubus sp.	Midnapore	Ockley	F.34	Rts.	
10-10-1-1 to 10-10-1-5	do	Lacombe	Bolten	F.34	Sds.	
10-11-1-1 to 10-11-1-10	do	Evansburg	Hargrave	F.34	Sds.	
10-12-1	do		Harcourt	F.34	Sds.	
10-13-1* to 10-13-7	do	Dropmore	Skinner	S.35	Rts.	
13-1-1 to 13-1-3	R. pubescens	Lacombe	Bolten	S.34	Rts.	Dead
13-2-1* to 13-2-11	do	Brooks	Griffin	S.34	Rts.	
14-1-1	Limnabotrya Lacustra	Lacombe	Bolten	S.34	Rts.	Flowered June 6. Spec. collected.
14-1-2	do	Lacombe	Bolten	S.34	Rts.	Flowered June 1. Spec. collected.
14-2-1	Grossularia oxyconthoids	Lacombe	Bolten	S.34	Rts.	Flowered June 2. Spec. collected.
14-2-2	do	Lacombe	Bolten	S.34	Rts.	Spec. collected.
14-3-1	do	Fort Simpson	Robin	S.34	Rts.	Fruit set June 1.
14-4-1 to 14-4-3	do	Edmonton	Hargrave	S.34	Rts.	Spec. collected.
14-5-1	do	Big Lake	Hargrave	S.34	Rts.	Spec. collected. Flowered June 1/35
14-5-2	do	Big Lake	Hargrave	S.34	Rts.	Spec. collected.
14-5-3	do	Big Lake	Hargrave	S.34	Rts.	

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
14-6-1 to 14-6-3	Grossularia oxyconthoids	Brandon Exp. Stn.		S.34	Rts.	specimen collected.
14-6-4	L. lacustra	Brandon Exp. Stn.		S.34	Rts.	specimen collected.
14-7-1	Grossularia oxyconthoids	Howie	Hannaford	S.34	Rts.	Specimen collected.
14-8-1 to 14-8-3	Grossularia sp.	Morrin	Rocke	S.34	Rts.	Specimen collected.
14-10-1*	do	Banff	Copemen	S.34	Rts.	
14-11-1 to 14-12-1	do	Midnapore	Ockley	F.34	Rts.	
14-13-1* to 14-13-3	G. oxyconthoids	Brooks	Griffin	F.34	Rts.	
14-14-1	Grossularia sp.	Obed	Hargrave	F.34	Sds.	
14-15-1	do	Brooks	Hargrave	F.34	Sds.	
14-16-1* to 14-16-2	G. oxyconthoids	Dropmore	Skinner	S.35	Rts.	June 6th.
14-17-1*	Grossularia sp.	McLeod	Sanden	F.34	Rts.	
14-18-1* to 14-18-13	G. oxyconthoids	Carseland	Moorehouse	F.34	Rts.	Plants 3 and 12 are L. lacustra.
15-1-1 to 15-1-2	Vitis sp.	Dropmore	Skinner	S.35	Rts.	
15-2-1	do	Brooks	Griffin	F.35	Ctgs.	Decayed.
15-3-1-1 to 15-3-1-7	V. vulpina	Brooks	Hargrave	F.35	Sds.	

Table III continued.

Plant Number	Species	Origin	Collector	Time Gathered	Type of Matl.	Remarks.
15-4-1-1	Mahonia aquifolia	Windermere	Hargrave	F.35	Sds.	
15-5-1* to 15-5-3	Vitis sp.	Brooks	Griffin	S.35	Rts.	
16-1-1	Vitis Idaea punctata	Fallis	Hargrave	S.34	Plant clump.	
16-2-1	do	R.M.House	Bfelgen	S.34	Plts.	
16-3-1	do	Slave Lake	Robertson.	S.34	Rts.	
16-4-1	do	MacKay	Hargrave	F.34	Sds.	
16-5-1	Oxycoccus palustics	Clyde	Hargrave	S.34	Sds.	
16-6-1	O. macrocarpus	Clyde	Hargrave	S.34	Sds.	
16-7-1	Vitis Idaea punctata	Clyde	Hargrave	S.34	Sds.	
16-8-1	O. macrocarpus	Clyde	Hargrave	S.34	Sds.	
17-1-1 to 17-1-6	Gaylussacia sp. or Vaccinum sp.	Blue River	Noble	S.34	Plts.	
17-2-1 to 17-2-4	Gaylussacia sp.	Slave Lake	Robertson	S.34	Plts.	
17-3-1 to 17-3-3	do	R.M.House	Blefgen	S.34	Plts.	Dead.
17-4-1	do	Blue River	Orchard	F.34	Sds.	Not planted.
18-1-1	Cyanococcus sp.	Rocky Mtn. House	Blefgen	S.34	Plts.	
19-1-1	Fragaria	Lacombe	Bolten	S.35	Plts.	
19-2-1	do	Lacombe	Bolten	S.35	Plts.	

Table III continued.

Plant Number	Species	Origin	Collector	Time Cath- ered	Type of Matl.	Remarks.
19-3-1	Fragaria	Lacombe	Bolten	S.35	Plts.	
20-1-1 to 20-1-6	Shepherdia Argentia	North Battle-ford	Sevick	F.34	Rts.	
20-1-1-1 to 20-1-1-3	do	do	Sevick	F.34	Sds.	Yellow
20 - 2 - 1 20 - 2 - 5	do	Brooks	Griffin	F.34	Rts.	
20-3-1-1 20-3-1-6	do	Brooks	Hargrave	F.34	Sds.	
20-4-1	do	Brooks	Hargrave	F.34	Sds.	Label 24 should be 20-4.
20-6-1-1 20-6-1-5	S. canadensis	Banff	Hargrave	F.34	Sds.	
20-5-1	do	Tapen B.C.	Partridge	F.34	Sds.	Label 25 should be 20-5
20-7-1-1 20-7-1A-10	S. argentia	Vegre-ville	Salomandick	F.34	Sds.	
20-8-1* 20-8-3	do	Brooks	Griffin	S.35	Rts.	
20-9-1* 20-9-4	do	McLeod	Sanden	F.34	Rts.	
20-10-1	do	Carse-land	Moorhouse	F.34	Rts.	
25-1-1 25-1-5	do					
20-7-1-1 to 20-7-1-10	do	Vegre-ville	Salomandick	F.34	Sds.	

* Cytological material.

Characteristics.

Corylus.- The northern parts and scattered southern parts of the prairie provinces have distributed over them, from east to west, one or other of the two forms of hazel nut. The species are Corylus cornuta, the beaked hazel nut, and C. americana, the lipped hazel nut. Chipman (10) said of the native hazel nuts:

"Growing all over our western provinces we have a valuable, but quite undeveloped, horticultural plant in our native hazel nuts. They grow wild in various places all the way from the northerly limit of our agricultural settlement. Many families gather them in the autumn and have a pleasant pastime cracking hazel nuts for their tasty kernels during the long wintery evenings. They are also used for cake, icing, candy, nut bread and other confections. Yet despite their great possibilities of development I cannot find that any one has ever cultivated them or that any selective breeding work has ever been done with them. We therefore have a pioneer field in which to work."

C. cornuta is the most widespread and shows the greatest variation. It is found as a small shrub 1 or 2 feet to 15 or 20 feet in height. Where it has a fair opportunity, without too much competition, the bushes are prolific bearers and vigorous growers. The nut of this type is covered with a husk that extends to form a beak. The husk is covered with

Dactyline.—

fine, sharp bristles that make harvesting unpleasant.

C. americana, the lipped hazel nut, never becomes more than a small shrub and is confiend to Manitoba, eastern Saskatchewan, and the Cypress Hills. It is hardy where grown in other parts of the prairies and lends itself well to cultivation and ornamental planting. The leaves of this species are brightly colored in the fall of the year whereas those of C. cornuta turn to a golden yellow. The nut when ripe is exposed at the end, and the lip-like edges of the husk curl back. This makes the nut easier to remove. C. americana starts bearing younger than C. cornuta.

Both species are self-sterile, sucker freely, and are attacked by the nut weevil. They can be propagated by suckers, from hard wood cuttings that have been stored over winter and rooted in a propagating bench with gentle bottom heat in the spring, or by budding and grafting.

In selection work with the hazel nut, care should be taken to save the late blooming types and types with catkins which are resistant to frost.

Amelanchier.-

This is commonly known in the west as Saskatoon. Elsewhere it is known as Shadbush, Juneberry, Shadblow, and Serviceberry. There are about 25 species of Amelanchier, most of which grow in North America. Of these, five have been reported on the prairie and are edible.

A. alnifolia is the most widely represented. Under natural conditions and varying habitats it ranges from a small

shrub 3½ to 4 feet high to a tree 20 feet high. It is one of the few fruits that ranges from the northern to the southern limits of the prairies. It is even found in the coulees of the driest regions. In the aspen community, Amelanchier forms the middle ~~stratum~~ stratum, and here it attains its greatest height. The racemes of white flowers are amongst the first to appear. Full bloom occurred at Edmonton on May 26 in 1935, which is a little later than usual due to the season. Earliness of bloom makes it subject to frost damage; otherwise, it is a consistent fruiter, and not subject to periodic production. The fruit of different plants varies widely in quality, size, sweetness, and juice content. It resembles the Huckleberry in shape but lacks the tartness of flavour. When fully ripe the fruit is deep purple. There are exceptions to this as red and white fruit are found. These lighter colors are found occasionally in large clumps and likely have arisen by natural hybridization, or by mutation. The white-berried form is high in pectin and of sweeter flavor than the dark berried.

The most promising type so far collected is from Saskatoon Lake in the Peace River district. The fruit of the plants in this collection is superior both in size and quality. This higher quality seems to be inherent rather than environmental. ~~as under cultivation the yield and quality is improved.~~ Under cultivation, the quality of fruit from the Lake Saskatoon plants continues to be superior to that of plants from other sources.

The collection from Dropmore is from stock selected and re-selected by F. L. Skinner who is a very keen observer and experienced nurseryman.

Under cultivated conditions, the Saskatoon is best grown in hedge row or clump and it makes an attractive ornamental planting. The plants are not particularly sensitive as to soil requirements. Under natural conditions they are found on both sour and sweet soils, and in partial shade or exposed to the sun. Material transplanted from the wild requires pruning to the ground level. In fact, the best success in transplanting is obtained by the use of roots alone. Suckers may also be transplanted successfully if severely pruned. Nursery stock, grown from seed, is successfully transplanted without this severe pruning. Selected material can be successfully budded on other Saskatoon stock where it makes a good union and vigorous growth. The length of life of a budded stock has not been tested. Pruning of the old wood keeps down disease and increases productiveness. The wood sometimes is attacked by a fungus disease which causes witches brooms. The foliage is susceptible to a bacterial blight. The fruit is widely used in the fresh state, in preserves, as a beverage, and dried.

Grossularia.-

Among the bush fruits the Gooseberry offers great possibilities for the fruit breeder. The English type gooseberry is superior in size and quality but is not hardy and the American type is only half-hardy in most regions. At least six species occur in the prairies. G. missouriensis (Nutt) Cov. and Britt., although not reported as occurring on the prairies of Canada, is common in Alberta south of a line from Coutts to the Cypress Hills. The other five species,

occur in some parts of the Prairie Provinces.
(Table II), ~~are widespread over the entire west.~~ They commonly form the under-bush on hillsides, riverbottoms, and poplar bluffs. There is a wide variation as to spines, habit of growth, and flavour of fruit. The majority are very thorny. The fruit is acid to taste, black to yellow in color, smooth, and low in yield. The plant collected by W. S. Watson at Colinton is possibly the exception in this regard. It is completely spineless, the fruit is sweet when ripe, and the plant is a vigorous grower. The one objection is that it tends to be prostrate in habit. This specimen has come from a moist, cool habitat.

The most promising material seen during my experience is that commonly found northeast of Medicine Hat at a place called Bull Springs and in scattered sheltered locations from there to Maple Creek.

Some characteristics of the various prairie gooseberries (including Limnobotrya) are as follows:

1. G. missouriensis (Nutt) Cov. and Britt. Strong upright grower, with few strong spines. The fruit varies in color from gold to dark purple and is well flavoured.

2. G. oxycanthoides (L) Mill. Low in yield. Under natural conditions, fruit small, tasteless, black when ripe, and smooth. Bush medium size, fairly compact, and very bristly.

3. G. cynosbati (L) Mill. Fruit tasteless, reddish black, rounded and elliptical, pubescent or prickly. Bush large with weak spreading branches. The wood is usually slightly bristled with thin spines at the nodes.

4. G. setosa (Lindl) Cov. and Britt. Very similar to G. oxycanthoides but not quite so bristly.

(Table 13), the widespread open-range system, only comparatively few ranchers participate in the Taylor Grazing Act program. Many of these ranchers have to depend on the public range for a part of their livelihood. Their operations are usually small, and they are not in a position to make improvements on the range. Many of the ranchers do not own enough land to support their livestock. They must depend on the public range for a part of their livelihood. Their operations are usually small, and they are not in a position to make improvements on the range. Many of the ranchers do not own enough land to support their livestock. They must depend on the public range for a part of their livelihood. Their operations are usually small, and they are not in a position to make improvements on the range.

5. G. inermis (Rydb.) Cov. and Britt. The spines at the nodes are few and the internodes are not bristly. The fruit has a glabrous skin.

6. G. hirtella (Michx) Spach. Somewhat similar to G. oxycanthoides.

7. Limnobotrya lacustris (Pers) Rydb. This species, although naturally found in very damp, even wet, locations, grows well under cultivation. Both stems and fruit are densely bristly.

Ribes.-

The currants are most abundant in the Parkland area. To the south and north of it they are found in scattered locations in river bottoms, in coulees, or where deciduous trees mingle with the conifers. Of the wild species, R. americanum Mill and Chrysobotrya aurea (Pursh) Rydb. are of greatest interest. The fruit of the former is highly variable in quality, high yielding, larger than average, sweet and black. The greatest drawback is their uneven habit of ripening. The bush is a strong grower, high and compact, but susceptible to mildew.

C. aurea is the tallest growing of our native currants and is found in the dry regions to the south. It is hardy and does exceptionally well under cultivation on the moist rich soil farther north. The fruit is variable in size and is larger than that of the commercial varieties but is very low in yield. The flavor and quality of the black (or yellow) fruits is superior in quality to that of the cultivated varieties and they seem to be resistant to the currant maggot.

Among Ribes petiolare, R. laxiflorum, R. hudsonianum,

4. *Amanita* (mycr.) Dev. and Peck. The species of this genus are not edible. The fruit body is poisonous also.

5. *Boletus* (mycr.) Dill. Another edible species of this genus.

7. *Lactocystis laccata* (Pers.) Berk. Edible. Mushroom. Mycelium. Cause soft water decay, very wet. Decomposes cause soft water conditions. Soft rotted not usually visible.

Plant.—

The organisms are also classified in the following way. To the south and north of it they are found in decreasing localities to other portions. In southern, as above mentioned they are dominate. If the soil contains *C. sanguinea* but the *Dendrocystis brassa* (Pers.) Berk. are of general interest. The limit of the tension is likely results in quality, high yielding, bigger corn growing, small tuber. The general decrease is likely because early ripening. The bush is a strong grower, high of resistance, not susceptible to mildew.

C. rubra is the richest variety of corn native Mexico and is found in the mountains of the south. It is early and does exceptionally well under cultivation on rich soils. Ears small but produce much. The fruit is yellow to light red in color. The kernels are long and slender. The cobs are small. The stalk is very low in quality. The leaves are few and narrow. The tassel is small and the ears (or ear) are borne near the ground. The husks are short and do not cover the ears. The variety is adapted to cultivation in the southern states.

Among other varieties, *C. indurata*, *C. saccharata*,

R. glandulosm and R. triste, the latter is the most important. This species is a trailer, is found in very moist locations and is resistant to mildew. The fruit is red, has a pleasant flavor, and is mild, sweet, and early.

The strongest and best fruited plants so far in the collection are those specimens of R. americanum Mill, from Howie, Alberta. The plants are upright growers and seem to be free from mildew.

Fragaria.-

The strawberry, represented by a number of species, is common in the wooded areas of the prairies and the foothills. Various forms are found in the shaded woods and open grassy meadows. The fruit is highly flavored. The plants make many runners and are completely hardy, even with no snow covering. Of the forms represented, F. americana, (Porter) Britt. and F. glaunca (S.Watt) Rydb. are the most interesting, especially the latter. F. glaunca is either closely related to or a form of, F. chiloensis Duchesne which is one of the parents of cultivated varieties.

The three groups in the collection show their marked difference in growth characters under cultivation. Here they will be much easier to identify than under natural conditions where environmental factors are involved.

Rubus.-

This genus is divided into three classes (a) the raspberry, (b) the dewberry, (c) the group into which fall R. articus L. and R. chaemaemorus L.

P. plumbiscan and *P. vitrina*, from Table 2, in pure bacteria.
Only exposure at 4 hrs/100%, in four of five bacteria
and in resistant to action. The result is pre, four a plasmic
flavor, and in all, cereal, and early.

The physical and test tension appears to due in the
collection are lower specimens of *P. vitrina* all, from
Idaho, Illinois. The flavor are slightly dynamic may seem to
be free from others.

Materia.—

P. plumbiscan (Lamb) Dyck. are the most numerous, especially
the larger. *P. plumbiscan* is either clearly-related to or a
form of, *P. oligospecta* common minor to use of the genetic
of sufficient variation.

The three (pairs) in the collection also vary among
themselves in (some) characters considered, their that
will be most useful to identify them under examined specimens
since environmental factors are involved.

Pubes.—

P. explicus L. and *P. plumbiscan* D.

The problem of identification and classification within the first group of species is as complicated here as in the eastern states. Rubus melanolasius Focke is the most widely distributed. Species escaped from cultivation and hybrids between them and wild species are common along highways and railroad beds. Forms are found from the prairie community to the rocky shores of Great Bear Lake on the Arctic Circle. They thrive equally well under both conditions. The flavor and hardiness exhibited make them of great value, although they seldom grow more than 3½ to 4 feet tall. The canes are densely bristly. The plants collected from Fort Simpson are remarkably vigorous, although they seem to have a dwarfed habit.

The dewberry is represented by R. pubescens Raf. This is widely spread in the moist woods, is a strong grower under cultivation, and is hardy, but is a poor bearer. Another species is reported from Manitoba, with a heavier type of wood and berries born singly.

R. articus L. and R. chaemaemorus L. are common in the muskegs. The latter extends beyond the line of tree growth in the north where the fruit is widely used.

Sorbus.-
It is not represented in the collection but is commonly found in the foothills and Slave Lake regions.

Crataegus.-
Crataegus occurs in scattered clumps throughout the wooded areas.

Prunus.-
The stone fruits comprise an important group on the prairies. Cherries and plums are represented. The former are most widespread from east to west and south to the far north.

Prunus nigra and P. americana are confined in the wild to Manitoba and southeastern Saskatchewan. These two species are now widely cultivated throughout the west. They are frequently found at the fords of rivers in an apparently natural state, in groves which are possibly the result of pits discarded by early settlers and traders. Selected varieties in cultivation vary widely in color, size, and flavor of fruit. With protection from the wind, they are completely hardy over the entire west and endure extremely low temperatures without damage. The short growing season which prevents ripening of the fruit, is a more significant winter factor than is winter cold. Buchanan (9), in tracing the history of plum improvement, pointed out that most of the improved varieties had originated from plums grown in Minnesota and Iowa. If breeding and selection work was conducted with selections from the farthest north points of their occurrence the season required for maturing should be reduced.

Prunus pumila L. and P. Besseyi Bailey are confined to the same ranges as the plums. A specimen of P. Besseyi has been obtained from The Pas district of Manitoba. During my inquiries or personal experiences I have not found it in the wild state in any part of Alberta. It has been reported in northern Alberta. However, these species are widely cultivated and selected varieties and hybrids between it and the plum (the sandcherry hybrids) are becoming increasingly popular.

Prunus melanocarpa (A. Nels) Rydb. is a shrub or a small tree that reaches 20 to 30 feet in height and 4 to 5 inches through the trunk. Like Amelanchier it is of widespread occurrence, being found over practically the same range. The fruit is borne in racemes and is usually black, but red and yellow fruited forms are present in the collection. The cherries are well known for their exceedingly astringent taste from which the species possibly derives its name. This puckery flavor disappears as the season advances or if the fruit is slightly frosted.

W. J. Boughen of Valley River, Manitoba, found a native chokecherry with little, if any astringency. This variety has been called "Boughen's Chokeless Chokecherry".

The habit of bearing the fruit in a raceme is variable. Frequently the raceme is broken up into a number of small racemes which hang in a cluster from the tree. This was very marked in the tree from which collection number 2-23-1 was gathered.

Under cultivation, it tends to sucker, but this is not any more marked than with the Manitoba plum. Grafting or budding on P. maackii or P. grayana overcomes this disadvantage.

Prunus pennsylvanica L. is a small tree which grows 15 feet tall in Alberta, with a maximum trunk diameter of 3 to 5 inches. It is most common in the parkland area, is very seldom found in the prairie, but extends north to the limits of timber. The fruit is borne on ~~short racemes~~ corymbs and blooms after the chokecherry. The cherry is dark red, thin skinned, and varies in acidity and size. Most of the trees do not set fruit well. Yeager and Berrigon (84) of South Dakota stated

that selected strains are heavy bearers.

In discussing the improvement of the pincherry Chipman (12) made the following statement:

"In response to my request in the August issue for the largest pincherries, I received quite a number of packages from Manitoba, Saskatchewan and Alberta. The largest one calipered an even one-half inch, the largest pincherry I ever saw, and came from 27 miles north of Brandon. The next largest was between the Lakes in Manitoba and calipered seven-sixteenths of an inch in diameter. Three others were notable for their extremely dark red flesh. All five of these had very firm flesh and retained their firmness for a considerable time. The very largest one was marked by an extremely small pit and all five were exceptionally mild and in flavor.

"I am of the opinion that we have been missing a bet in not improving the pincherry by selective breeding to develop large firm hardy cherries for jelly, jam, canning, pies and dessert. We have improved our wild plum and our wild sand-cherry to a truly amazing degree by the simple method of growing more seedlings, picking out the best and growing more seedlings, I am sure we can do likewise with pincherries."

Vitis.- The wild river-bank grape, V. vulpina L., is found in southern Manitoba. It is a vigorous vine when cultivated, does well wherever transplanted on the prairies, but needs careful protection. Mahonia aquifolium Nutt, the Oregon grape, is found in the southwestern corner of Alberta. Its main value is for ornamental plantings, but the fruit, which is a small blueberry, is edible and good for wine.

Shepherdia.-

Of the two forms, S. canadensis (L) Nutt, and S. argentea Nutt, the fruit of the latter is the most widely used, either wild or cultivated.

S. canadensis is found in the deciduous and coniferous forest areas. It forms a part of the lower shrub layer. The fruit varies in flavor but is usually insipid. That of the plants found growing in the sphagnum swamps is tart and is frequently used in the preparation of a relish. These latter plants tend to dwarfness in habit.

S. argentea, the Buffaloberry or Bullberry, is a dioecious shrub with silvery grey foliage. It grows about 10 feet tall. The branches are thorny making the fruit, which is born on female plants, hard to gather. The fruit is small-seeded, is borne on large clusters, and varies from golden yellow to deep red when ripe. It is found most abundantly in the prairie community and occasionally penetrates into the parkland. This shrub is possibly the hardiest and most drought resistant of our wild fruits. It is one of the first to bloom. The fruit is ripe in July. When dried the fruit resembles currants in appearance and flavor.

The collection has two groups of particular interest, although the plants have not yet reached maturity. One from North Battleford has exceptionally large fruits, the other from Salomandick of Vegreville is the result of several years of selection.

Vacciniaceae.-

The cranberry, blueberry, and huckleberry are included in the family Vacciniaceae. There are four species of cranberry on the prairies. Three of these, Oxycoccus macrocarpus

the Mayors.—

Of the two Towns, Ja. Ochterlony (1) incl. and
Ferguson incl. the Heads of the Letter I. the most Eastern
head, stands with a Quadrangle.

I. Constantia in Town to the Southward and Westerward
out Town's Limits. It forms a Part of the Inner Circle Square.
The Small Square in Plan No 10 is usually called. Square
the Plants round pointing to the Compass should be open and
is frequently used in the Composition of a Design. These
Garden plants have to Compliment in Trees.

K. Augustus. the Southwestern or Northern, is a
close into about Main Military Town Ensign. It forms about
10 feet wall. The Dimension are Country Seller the Small
Square is Town on Square Plant, Main to Square. The Small is
well-wooded, in Point on Large Gateway, and Hedge Square
Garden Pallas to Long Tree Main Main. It is Front Well Square
Walk in the Public Assembly and Recreation Square Trees
the Parlour. This Plant is Usually the Wanted and Most
Thought Merchant of Our City Spring. It is Use of the Trees
to Bloom. The Trees to Plan to Fill. Their Color Are Bright
Meadow Surrounded to Appearance Our Flower.

The Collect in Are Low Trees of Particular Interest,
Although the Plants were Not Planted Recently. The Large
Tropic Temperature Has Accelerated Large Growth, the Flower
Tree Location or Imported is It Is Would to Natural Trees
of Deciduous.

Conclusion.—

The Character, Numerous, Are Characters Are Tree Most
In the Daily Recognizance. There are Trees Tree of Deter-
mery or the Parlour. Flower of Those, Tree Square Square

(Ait) Pers., O. microcarpus Furez, and O. palustris Pers grow on the sphagnum muskegs common throughout the northern parts of the prairie provinces. O. macrocarpus is the species offered for sale on the markets and cultivated in the east. It has the larger, sounder berries, borne on bigger plants; it is hard to distinguish between O. macrocarpus and O. microcarpus. The berries of O. microcarpus and O. palustris are soft and would not lend themselves to packing. No attempt has been made at cultivation in the northern districts and the wild product is seldom seen on the market.

The fourth species, Vitis-Idaea punctata Moench, the mountain cranberry, has entered into commercial horticulture. In the fall of the year it finds a ready market and is gathered in large quantities in the northern districts. The plants form the ground cover, under open spruce and pine forest as well as in the open moss covered glades. The foliage is evergreen and the berries remain edible throughout the winter and into the following spring. If carefully moved they have been found to thrive under cultivation on the Edmonton soils.

The blueberries and huckleberries are widely represented in the northern districts of the prairie provinces and the foothills of the rockies. The species vary in height from 2 inches to 1½ feet. Where the people have made a habit of picking them for sale they frequently burn the large natural patches, but they are not cultivated commercially. The fruit is common on the markets in the fall and that of the huckleberry demands a premium. These fruits are possibly the most widely

commercialized type of wild fruit and as the natural sands disappear some attempt will be made to improve and cultivate them. If young plants are moved from the wild, early in the growing season, they will grow and fruit on the black soils.

Sambucus.- The native elderberry is the least recognized of all the shrubs. Forestry men report it as occurring in a wide range through the forest reserves. The specimens in the collection were gathered at Obed at an elevation of 3,560 feet on timber slashing. The parent specimen was hardy and had reached a height of 10 to 12 feet, where the moose had not browsed it down (as they often do with this and Sorbus). The berries found were a reddish purple in color and were borne in large clusters. The foliage is not finely cut.

Viburnum.- V. trilobum, the Pembina Berry or High-bush cranberry, is much more frequently eaten than V. eradiatum, the Squash Berry. The latter occurs more commonly throughout the woods and river bottoms, but is not a heavy bearer and does not respond to cultivation. Three to four feet is the maximum height attained and there is only one single upright shoot in the majority of cases.

The Pembina Berry is a shrub, 12 to 15 feet tall. Under cultivation, it will grow in direct sun or shade, thriving under both but in the wild it is found in shady moist places in lake and river valleys. There is wide variation in the shape and size of the fruit and of the clusters. It is one of the last fruiting shrubs to bloom, hence it is seldom damaged by late spring frosts and bears crops consistently. The fruit is

commercialized type of video game to the primary cause of-
another some authors will be ready to disagree with certain conc-
lusions. Many will argue that the video game is the product
needed, they will argue specific on the video game.

Conclusions.-

The media alternative is the least recognized of all
the choices. Investing more effort in the operation in a like
manner because the current practices. The alternative is not rec-
ommended more research is done by the advertising of video game
on tables elsewhere. The survey questions may simply not be
recorded a bright or in to it best, where any people may not
answered it does (as they video or with this was answer). The
Internet found more a question maybe to notice and more those in
large elsewhere. The Nielsen is not timely use.

Viewpoint.-

In [illegible], the results must be [illegible] research,
is just more frequently asked that [illegible] are answer
here. The survey answer more commonly investigate are those
and video games, but it can a newly before not does [illegible] re-
spond to activities. There to have that is be actions better
obtained and there is only one single question used in the
majority of cases.

The Nielsen Story is a study, as to be used bell. Inter-
activities, it will give to fixed not be cases. Include
under both but is the this it be cases it small with [illegible]
late and river village. There to also television of its more
and-size of the fault the of the clusters. It is not after
last trading stores to those, cases it by nielsen research
take spring sheets and make color conditions. [illegible]

is ready for use as soon as it starts to color, when its pectin content is the highest. However, the clusters hang on the tree all winter and the fruit is fit for use at any time. The one objection to this fruit is the peculiar odor during cooking. This, however, is not usually carried over in the preserved form.

Lonicera villosa or Xylosteon villosa are the edible honeysuckles of northern Manitoba. This handsome ornamental shrub grows to about 5 feet in height. The fruit is oval, bluish black in color and pleasantly edible.

W. R. Leslie, in a weekly news letter late in 1935, Experimental Farm Morden Manitoba, commented on Lonicera villosa as follows:

"Local experience is that this northern Manitoba honeysuckle is more pleasing as desert and as a canned fruit than the Asiatic species known as the Edible Honeysuckle. Should the native not thrive here on its own roots, the Chinese prototypes may furnish satisfactory rootstock for it. The Sweetberry Honeysuckle is usually not over 2 or 3 feet high, with branches and buds pointing upwards, and branchlets and leaves densely covered with fine hairs. The bark is yellowish brown and flaky. The edible fruit is blue, suggesting a gooseberry in shape, and although a large specimen may be nearly a half inch in length, many of the berries will be 1/4 to 1/3 inch long. Flavour resembles a moderately tart blueberry."

Summary.

An effort has been made to collect the various wild fruits on the prairie provinces and describe certain of their characteristics. The field explored has received little attention in the past in systematic fruit breeding projects.

During the year and a half since the work was started the collection has reached appreciable proportions. Its value should increase with time for future classification, breeding, and genetic studies. At the present time, certain of the collections seem to be particularly useful. Among these should be noted: (a) the plants of Corylus americanum from Griffin and Skinner, and the seedlings of C. cornuta from the seed collection made by Chipman of the Country Guide; (b) in Amelanchier, the budded stock from Wilson, which came originally from Lake Saskatoon, the seedlints from Skinner, and the plants in the collection 1-10-1 to 1-10-6 from Griffin; (c) the gooseberry specimen from Watson; (d) the currant cuttings from Coutts, which are from exceptionally vigorous, drought resistant plants with high quality fruit ranging in color from yellow to purple; (e) the raspberry from Fort Simpson; (f) in Prunus, the collections 3-1-1 to 3-1-5 were propagated from remarkably large trees; (g) the specimens in Shepherdia which have been mentioned and refer to 20-1-1 to 20-1-6, and 20-7-1-1 to 20-7-1-10.

Some idea of the distribution has been obtained and presented, and a further realization of the wide adaptability in the native genera has been made clear. Whether the intermediate and exceptional types are due to environment, natural hybridization, selection within the species, or mutation is a matter of conjecture. That they occur is a significant feature. With reasonable skill, the fruits can be cultivated, and with the exception of the Vaccineaceae, have responded vigorously to the treatment given them.

If the native fruits contribute nothing but hardiness, a conservative assumption, this one good point is of great value. The value of hardiness to horticulture in the prairie provinces and its possibilities in organized breeding projects have been realized in the apple. The Siberian crab (Malus baccata) has contributed only the one valuable character of hardiness, but this has become associated with larger size of fruit, higher quality, and a number of other characters. It does not seem too much to assume that results comparable to those in the apple can be accomplished with the wild fruits of the prairie provinces.

PART II

SEED GERMINATION.

Introduction.

A recent publication (72) from the Department of Horticulture, University of Alberta, with the present writer as a junior author, discusses the propagation of trees and shrubs from seed and was prepared in the course of this investigation. That publication may be referred to for certain details on the subject which it seems unnecessary to review here.

Due to the ease of securing the material and the lower transportation charges, a large number of the collections, as mentioned previously, were comprised of seeds. Many of the collections were small and necessitated careful handling to obtain good germination.

Little information was available on germination of many of the species collected when the study was begun. With the preliminary methods used, seed of some of the collections did not germinate. The requirements of practically all of the wild fruits have now been worked out reasonably well.

Literature Review

Crocker (13) maintained that dormancy in seeds is associated with factors such as follows: (a) inhibition due to one or more of the processes which accompany germination, such as growth of the embryo or physical character of the seed coat; (b) seed coat failing to enter into both primary and secondary dormancy; (c) after-ripening processes which involve growth of a rudimentary embryo, fundamental chemical changes in a mature embryo, or chemical changes in the seed coat; (d) a relationship between embryo, dormancy, and seed coat.

Eckerson (30) examined Crataegus seed each week during after-ripening at 5°C. She noted the following: (a) higher water-holding capacity and increase in acidity at an early stage; (b) increase in catalase and peroxidase activity; (c) replacement by sugar of the food stored as fat and oils, toward the end of the after-ripening period.

Sherman (71) corroborated the work of Eckerson in relation to catalase activity, as did Davis (21) with Cornus florida and Sambucus canadensis.

Pack (59) in experiments on after-ripening of Juniper seed found that the phosphatides increased, whereas the lipoids decreased. There was also an increase in acids and sugars.

Flemion (31) found the same reaction in S. aucuparia as did Eckerson (30) in Crataegus, and also that emulsin

and amylase remained unchanged. Both the seed coat and the dormancy of the embryo were inhibiting factors in S. aucuparia.

Crocker and Barton (17), Davis and Rose (24), Flemion and Giersback (31, 32), and Crocker (17), found that in most seeds in Rosaceae the germination is retarded by the seed coat and by dormancy of the embryo. These inhibiting factors can be overcome in Prunus and Malaceae, Sorbus (31), Tilia (4), Cotoneaster (38), Pinus (3), and Betula (81), by after-ripening at temperatures slightly above the freezing point.

Crocker (16) pointed out that stratification refers to the old method of placing seeds and sand in successive layers and exposing them to cold or freezing conditions. The present method is to place the seeds in a suitable medium and hold them at a certain definite temperature. He further stated that the function of the medium is to give an optimum of moisture and air to the seeds while being held at the desired temperature. Sand, peat, or soil fulfill the requirements if they are free from injurious substances. In general, peat is best, as it holds a large percentage of water and still supplies good aeration.

Crocker (15) stated that all work, up to that time, established that rosaceous seeds did not require freezing to complete the dormancy period. Freezing will not bring about after-ripening.

Davis (23) found that oxygen was necessary for the after-ripening of Ambrosia seeds.

Flemion (33) was able to obtain seedlings of peach, apple and hawthorn by removing the embryos and placing them under germinating conditions without after-ripening. These seedlings made very little growth for several months then they began to grow normally.

Deuber (26) found that ethylene chlorhydrin and thiourea hastened germination of Norway maple, black oak, and red oak seed. Flemion (31) was unable to get any beneficial effect from these chemicals or many others in attempts to hasten the germination of Sorbus aucuparia seed. She noted that seeds of Sorbus have a stronger dormancy than the seeds used by Deuber.

Crocker (14) described a secondary dormancy in seeds. Seeds that had been partially or completely after-ripened, if exposed to a high temperature, reverted back to their original dormant condition and required a second period of low temperature treatment.

Crocker and Barton (17) found that Amelanchier canadensis germinated best after four months after-ripening at 1°C. and 5°C. After four months the seed started to germinate at the low temperature.

Giersback and Crocker (39), in experiments with wild plum seed (Prunus americana), obtained better germination with a shorter period of after-ripening (less than four months), when the seed was stored at room temperature before stratification.

Davis (20) found that seed of Viburnum americanum has two distinct developmental stages. The first is the growth of a rudimentary embryo which takes place at temperatures above 68° F. in about 60 days. The second is an elongation of the radical which requires about 60 days at 40°to 50° F. After this, normal growth takes place in a greenhouse temperature of about 68° F.

Davis (20), in work with Sambucus, explained the results of previous workers by showing that freshly harvested elderberry seed contains viable and dormant embryos. The former germinated readily, whereas the latter required 100 days at a temperature between 32°F. and 41°F., and then alternating temperatures, before germination took place.

Materials and Methods in Germination of Seed.

Work of 1934.-

As the collections were received, or made, in 1934, the seed was washed from the pulp by soaking in water. It was then dried, placed in paper envelopes, and stored dry, at room temperature, until December 12. The seed was then sown in flats containing soil. Each flat was divided into sections to avoid the possibility of mixtures occurring between the collections. After sowing, the flats were well watered and taken to a root cellar where they remained for a period of 120 days. The temperature of the root cellar ranged between 1°C. and 4½°C. On April 11, the flats of

of all collections were removed to the greenhouse and watched for germination. The dates of germination were recorded and a note made as to whether it was poor, fair, or good.

All of the material received the same treatment, with four notable exceptions: (a) in collections of Corylus a part was stratified in sand for the same period and under the same conditions as for the main portion of the collection and a second part (100 nuts) was sown in a flat and exposed to greenhouse conditions; (b) the collections of Sambucus were divided evenly into two groups. One was treated the same as the 100 nuts of Corylus, the other was sown and placed in a root cellar; (c) each of the Oxycoccus and Vitis-Idaea groups were divided. One half was sown immediately on sphagnum moss in aquarium chambers which were kept moist with snow or rain water. The balance of the seed, from these two groups, was sown in flats. The soil was from the same type as that on which the mother plants of Vitis-Idaea were found growing. The flats were placed in the root cellar where they remained until April 11; (d) the collections of Viburnum were sown the same as the remainder of the collection. However, instead of being placed in the root cellar they were exposed to a temperature above 68°F. for two months. On February 18 they were removed to the root cellar for a further two months period at the low temperatures. The flats were removed with the balance of the material on April 11.

The flats of seed from these four special cases were treated the same as the remainder of the collections from the time they were removed to the greenhouse. The nuts of Corylus

of all relationships more removed to the determinant (or dependent). The names of determinative words (singular and plural) are to be written in ink, pale, or red.

All of the preceding remarks are also applicable to words which have modifying connections; (a) by the placing of adjectives after the words modified as for the most part in French and Spanish and a modern form (this usage is a clear and decisive determinative connection); (b) the use of particles or connecting words (often small) for all kinds of connections; (c) the use of the determinative and relative pronouns; (d) order of the determinative and relative words; (e) order of the determinative and relative phrases; (f) the use of inflections to express the relations of the words to each other. The relations of the words, then, are known by the use of the words in connection with other words, by their position in clauses, the order of the clauses, and the inflections of words. The first two classes of connections are the most important. The third class is the most obscure in the most modern languages, while the fourth is: (1) the connections of inflections with each other and (2) the connections of inflections with the words to the exclusion of the connection. However, because of their clearness to the mind either one or both of these connections is the most common in modern usage, for the learner. In whatever it may be resolved to the most obscure for a time to the modern learner as the two extremes. The first is clearest of all the different ways of the determinative to modify it.

The first of these three types is the most common and is the basis of the determinative phrase. The second is the most obscure of the three types. The third is the most common in modern usage.

that had been stratified in sand were sown in flats and placed in the greenhouse.

As the seedlings became large enough, they were potted into thumb pots and gradually hardened off. Some of the seedlings were shifted later to 2½ inch pots. The material that was not shifted was planted outdoors. The Oxycoccus and Vitis-Idaea seedlings were very small. Instead of potting them, they were pricked out into flats of soil, and grown under shade during summer. The soil was similar to that in which they germinated.

Work of 1935.-

The results obtained with the 1934 collections of Amelanchier and P. pennsylvanica were not satisfactory. In the hope of learning more in respect to their gerimation, it was decided to test them further during the winter of 1935-36. Seeds of Lonicera caerulea were tested at the same time as Amelanchier and Prunus because this species had not been included in the work of the previous year.

Care was taken to see that the seed was fully mature when gathered. The pulp was removed by washing and care taken not to soak the seed longer than necessary. The Amelanchier seed was stratisfied on August 17. Sufficient for checks was stored dry. The seed of L. caerulea received the same treatment as that of Amelanchier. The seed of P. pennsylvanica was divided into four groups. These were treated on August 13, as follows: (a) the first group was after-ripened in the regrigerator, (b) the second group was after-ripened in the root cellar, (c) the third group was stored dry until November

14, at which time it was stratified and after-ripened in the refrigerator, (d) the last group was kept dry as checks.

The seeds were placed between layers of cheese cloth, in granulated peat, in petri dishes, all previously autoclaved for six hours. The peat tested pH 5.5, hence was slightly acid in reaction. The peat and seeds were examined periodically for mold and moisture content. Mold that did appear was washed out carefully before returning the material to the refrigerator.

The refrigerator was electrically cooled and regulated to the desired temperature of $1\frac{1}{2}^{o}$C. to 3°C. The temperature in the root cellar varied from 2°C. to 4°C. but was constant at $3\frac{1}{2}^{o}$C. during the greater part of the time.

At intervals of one month, the desired number of seeds, of each group, were removed from stratification. These were planted in flats, exposed to greenhouse conditions, and the germination recorded.

Preliminary Results.

In 1934, a wide variation in seed germination resulted (Table IV and V), due, possibly, to the varying treatment of the seed before it was received. It should be noted that fair to good success was obtained with all seeds except those of Amelanchier, Prunus pennsylvanica and Viburnum. The first two mentioned were those tried again during the winter 1935-36. The seeds of Prunus melonacarpa had started to germinate when removed from stratification.

Table IV. Seed Collections Stratified on December 12, 1934, and Held in Root Cellar Until April 11, 1935, at 1° to 4½° C.

Number	Name	Date of Germination.	Rating
1-12-1	Amelanchier sp.	April 23	Poor
1-13-1			None
1-14-1			None
1-15-1			None
1-16-1		April 14	Poor
1-71-1			Poor
1-18-1			Poor
2-8-1	Prunus melanocarpa	April 20	Good
to			
2-10-1			
2-11-1		April 21	Good
2-12-1		April 21	Good
to			
2-13-1		April 18	Good
2-14-1			None
2-15-1		April 19	Poor
2-16-1		April 18	Fair
2-17-1			None
2-18-1		April 18	Good
2-19-1			None
2-20-1		April 21	Fair
2-21-1			None
2-22-1		April 22	Poor
2-23-1		April 20	Poor
3-7-1	Prunus pennsylvanica	April 19	Poor
3-8-1		April 19	Poor
3-9-1			None
3-10-1			None
3-11-1			None
3-12-1		April 18	Poor
3-13-1			None
3-14-1		April 18	Poor
6-7-1*	Corylus cornuta	Jan. 4	Poor (12 seedlings from 100 seeds.)
6-7-1		April 14	Fair
7-14-1	Ribes	April 23	Good
7-15-1		April 23	Good
8-4-1	Ribes		None

Table IV continued.

Number	Name	Date of Germination	Rating.
9-1-1*	Sambucus sp.	Jan. 7	Fair
9-1-1		April 18	Good
9-2-1		April 16	Good
9-2-1		Jan. 10	Fair
10-10-1	Rubus melanolasius	April 24	Fair
10-11-1			Good
10-12-1			None
14-14-1	Grossularia	April 18	Poor
14-15-1		April 17	Good
15-3-1	Vitis vulpina	April 26	Good
15-4-1	Mahonia aquifolium	April 23	Good
16-4-1	Vitis-Idaea punctata	April 14 to 20	
16-4-1		do	Good
16-5-1	Oxycoccus palustris	April 16	Good
16-6-1	" macrocarpus	April 16	Good
16-7-1	Vitis-Idaea punctata	April 16	Good
16-8-1	Oxycoccus microcarpus	April 16	Good
20-1-1 to 20-1-6	Shepherdia argentea	April 25	Fair
20-3-1		April 25	Good
20-4-1		April 25	Fair
20-5-1	" canadensis	April 29	Fair
20-6-1		April 25	Good
20-7-1		April 25	Good
20-7-1A	" argentea	April 25	Good

* Two of three exceptional cases discussed in text.

Table 21 continued.

Table V. Viburnum Seed* Stratified on December 12, 1934, and Held Until February 18, 1935, above 68°F. and then until April 11 in the Root Cellar, at 34° to 40° F.

Number	Name	Date of Germination	Rating
4-7-1	Viburnum trilobum		None
4-8-1			None
4-9-1			None
4-10-1 to 4-15-1		April 22	Fair
5-4-1	" eradiatum		None
5-5-1			None
5-6-1			None
5-7-1		April 28	Fair

* The third exception discussed in text.

.o germination occurred in

until after the sixth month.

.d at the end of the seventh month it

.nation had taken place in refrigeration

veen $1\frac{1}{2}^{\circ}$ and 3° C. at some time during

The root tips had just emerged a short

.e of discovery.

Table 1. Literature Search (Specialties in Chemistry 32, ...
and Math Texts Included) 13, 1970, ...
Four Year Small Liberal Arts Colleges, ...
[illegible] to NSF 71.

Four months (120 days) of after-ripening gave satisfactory germination in all the cases treated similarly. The four special cases gave the following results: (a) in Corylus 12 seedlings were obtained from the 100 nuts in the greenhouse. The balance of the nuts gave fair germination after 120 days of after-ripening. (b) in the two groups of elderberry seed, results similar to those of Corylus were obtained. Each group of seed germinated but that group after-ripened for the four-month period gave much higher percentage of seedlings. (c) the seeds in the family Vaccineaceae which were sown on sphagnum, did not germinate. Those sown in soil and after-ripened gave good but slow germination. The seedlings did not grow quickly, having reached the two-leaf stage at the time of pricking out, and the four-leaf stage by the end of the growing season and were too small to handle. (d) the results with Viburnum sp. were not as high as expected. Only two seed samples gave any germination. (Collections 4-10-1 to 4-15-1, received from Chipman of the Country Guide, were the result of a contest held for the best seed clusters of V. trilobum gathered in the prairie provinces.)

Results in Amelanchier, Prunus and Lonicera.

The results of germination tests conducted during the period 1935-36 are summarized in Table 6.

With A. alnifolia seed, no germination occurred in either check or treated groups until after the sixth month. When the seed was examined at the end of the seventh month it had germinated. Germination had taken place in refrigeration at a temperature between $1\frac{1}{2}^{\circ}$ and 3° C. at some time during the seventh month. The root tips had just emerged a short distance at the time of discovery.

Table VI. Germination of Seeds Rested During the Winter of 1935-1936.

Species	Treatment	Temp. ° C.	Date of sowing.	Months of after-ripening. 1	2	3	4	5	6	7	8
				%	%	%	%	%	%	%	%
P. pennsylvanica	Refrigerator	1½-3	Aug. 13	0	0	0	0	0	0	0	0
do	Root cellar	2-4	Aug. 13	0	0	0	0	0	0	0	0
do	Dry to Nov. 14 and refrigerator	1½ -3	Nov. 14	-	-	-	0	0	2	4	12*
do	Check		Aug. 14	0	0	0	0	0	0	0	0
A. alnifolia	Refrigerator	1½ - 3	Aug. 17	0	0	0	0	0	0	95**	-
do	Check		Aug. 17	0	0	0	0	0	0	0	0
Lonicera caerulea	Refrigerator	1½ - 3	Aug. 13	0	0	74	86	80	84	-	-

* Germination not complete at time thesis written.

**Estimated. The seeds germinated in stratification, hence they could not be counted without damage to the roots.

The germination tests on Prunus pennsylvanica have not been completed. The results to date are interesting in that not one of the four groups showed any germination up to the end of the fifth month. Furthermore, the checks, and the two groups stratified immediately on being picked, have not germinated to date. It is noteworthy that the group stored dry until November 14, and then stratified and after-ripened in the refrigerator, started to germinate after the sixth month. The percentage germination increased after the seventh month, and, at present, has reached 12 percent after the eighth month of after-ripening. The kernels and embryos to all appearances are still in good condition in all the remaining groups. The seed in the check group, yet in a dry state, has not shrunken visibly.

Lonicera coerulea gave 74 percent germination after the third month of after-ripening and a slightly higher percentage after the next three months. The seed did not germinate at low temperatures, nor did the continued treatment lower its viability.

Discussion of Seed Germination in 12 Genera of Wild Fruits.

The data presented in Table VII are a summary of the work done with various species.

Table VII. Seed Germination in 12 Genera of Wild Fruits.

Name of Plant	Treatment	Best Temp. for after-ripening.	Days for after-ripening	Remarks
Amelanchier	After-ripen and sow in spring	35-50°F.	200	Hard to germinate. Good practice to pick before fully mature and sow and stratify at once. Will germinate at 32°F.
Corylus cornuta	do	do	90 plus	Sown outdoors takes two years to germinate. Preliminary study tends to show unequal dormancy in fresh seed.
Lonicera villosa	Sow in fall, or after-ripen and sow in spring.			Germinates after one month at 35°F.
Mahonia repens	Sow as soon as ripe, or stratify and sow in spring			
Prunus Besseyi	After-ripen and sow in spring	33-50°F.	90	
Prunus grayana	do	do	90	
Prunus melanocarpa	do	do	150	Watch for germination after 110 days.
Prunus nigra	do	do	150	

TABLE VII continued.

Name of Plant	Treatment	Best Temp. for after-ripening.	Days for after-ripening	Remarks
Prunus pennsylvanica	After-ripen and sow in spring.	33 - 50°F.	90 - 150	If stored dry for 2 months, germination starts in 90 days.
Prunus pumila	do	do		
Ribes	Expose to cold			Watch carefully for germination as this takes place at low temperature.
Rubus	After-ripen and sow in spring	33 - 40°F		
Sambucus	Stratify and sow in spring			Uneven dormancy. Best to store, stratify, and sow very early in spring.
Shepherdia	After-ripen and sow in spring	33 - 50°F.	120	Sow seed as soon as ripe or after-ripen. Seedlings sensitive to light.
Vaccinium	do	do	120	Sow under pane of glass in greenhouse. Seedlings are very small and difficult to handle.
Vitis	Sow in spring or after-ripen	do	120	
Viburnum				Wash from pulp. If sown outdoors it takes 2 years to germinate. To gain a year (a) stratify and after-ripen at 68° constart or higher temperature (never lower) for 60 days.(b)then store at 40 to 50°F. for 60 days. Sow at approximately 70.

Crocker and Barton (17) working with seed of Amelanchier canadensis (L) Medis found that it germinated after three or four months of after-ripening at temperatures of 1° C. and 5° C. Then the seed started to germinate at the lower temperature. In the present work, A. alnifolia was found to require a much longer period of after-ripening at 1½° to 3° C., (200 days) which emphasizes the fact that requirements vary with individual species. The checks, which were not after-ripened, did not germinate. Furthermore, the tests have indicated that care must be taken to watch and remove the seed as soon as germination starts under the low temperatures. The results offer a possible explanation of the difficulty encountered by nurserymen in obtaining a stand from seed sown in the fall as soon as ripe, whereby it is allowed to germinate whenever it is ready to do so. The ground usually freezes soon after fall planting with a resultant lowering of the temperature below which the seed is best held, consequently the after-ripening process stops. Between break up in the spring and the coming of warm days there is not a sufficient period of time with temperatures between 0° C. and 5°C. to complete the after-ripening process. The result is that the seed lies in the ground for another season and completes the process only when the soil temperatures become suitable. This would possibly occur the following spring. If the conditions are not suitable for growth after germination the seedlings will perish.

An initial dry storage period, before stratification, hastens the germination of P. pennsylvanica. In this species

germination started after 3 months of stratification with seed that had been stored dry and has increased each month, reaching 12 percent after the end of the fifth month. A longer period of dry storage might further shorten the after-ripening period. Giersback and Crocker (39), found that the seed of Prunus americana stored dry for a period before stratifying at 5°C. improved in its ability to germinate over that of seed stratified as soon as harvested.

Varying percentages of seed of Corylus cornuta germinate when freshly harvested and after a period of after-ripening. This bears out the belief that the embryos of Corylus enter dormancy at different times or have rest periods that are easily broken.

Prunus Besseyi and P. grayana give high germination with a 90 day period of after-ripening. After this period they will germinate at a temperature very little above freezing. P. melanocarpa gives successful germination after a 120 day period of stratification at temperatures between 1° and 8° C. A shorter or longer period is better if the seed is carefully watched and removed when germination starts.

The seeds of Ribes and Rubus germinate successfully after 120 days after-ripening. Both required, however, long periods under greenhouse conditions. With Ribes, it would possibly be a better policy to expose the seed to after-ripening until it started to germinate, at which time it could be planted.

could be planted.

A percentage of Sambucus seed will germinate as soon as gathered. If an early start is required, sowing of the seed at this time might be an advantage but a higher percentage germination is obtained if the seed is afterripened.

Shepherdia, Vaccinium, and Vitis gave good germination after the 120 days stratification in the root cellar. Germination in Viburnum seed was not satisfactory except with the two collections mentioned in the results. The collections from Chipman were possibly gathered while the fruit was slightly immature. They were never completely dried out, being sown as soon as they were removed from the pulp. Collection 5-7-1, was gathered when fully mature but remained in the pulp until shortly before sowing. This may be the explanation for the results obtained.

Summary

1. The optimum period for after-ripening has been determined for certain species, and the requirements for fair to good germination have been noted for others.
2. A high percentage of germination results when seeds of wild fruits are subjected to temperatures of 1° to 5° C.
3. When the period for after-ripening has been completed, seed of Amelanchier alnifolia and Prunus pennsylvanica will germinate at the low temperature of $1\frac{1}{2}^{\circ}$ C. If not removed from the stratification medium soon after germination the seedlings will perish.
4. Dry storage, at room temperature, shortens the period required for after-ripening of Prunus pennsylvanica.
5. Germination in Lonicera, after reaching its high point, remains consistently high when the seed is held for an extended period at the after-ripening temperature.
6. Seedlings of Oxycoccus microcarpus, O. macrocarpus, O. palustris, and Vitis-Idaea punctata can be germinated and grown for a year at least in soil, which is contrary to a widely held belief.
7. Seed of Viburnum trilobum and Viburnum eradiatum should not be allowed to dry during the period between washing from the pulp and stratification.
8. Corylus and Sambucus have irregular dormancy periods.

Abstract

PART III

CYTOLOGICAL STUDIES IN THE WILD FRUITS

Introduction

A knowledge of chromosome numbers of the native fruit species in the prairie provinces would aid greatly in breeding projects which aim to incorporate valuable characters of these species. With this in mind, and with the hope of clarifying the classification, this work was undertaken. Chromosome numbers have been determined in six species native to the ~~West.~~ prairie provinces.

Literature Review

The haploid chromosome number in Corylus americana and C. cornuta has been given by Wetzel (79) and Jaretzky (43) as 11. Later work by Woodworth (82) showed that n= 14 in C. cornuta Marsh and C. americana Walt. and that this number was constant for all the species in Betulaceae. This is interesting because of the close relationship to the highly polyploid species of Betula. He reported that in C. americana, at metaphase, there were three large clumps each composed of two gemini. Cytomyxis was frequent with migration of the chromosomes across the plasma bridge. The heterotypic divisions in C.cornuta Marsh were irregular and

showed lagging chromosomes. Various counts from 8 to 14 were explained by fusion of the chromosomes or their loss during cytomyctic migration. There was a noticeable difference in the size of pollen, 5 percent of which was defective.

Meurman (55) found the somatic chromosome number to be 16 in twenty-two species of Ribes and their hybrids. The species investigated included R. aureum Pursh, R. americanum Mill., R. lacustre (Pers.) Poir, and R. rubrum A. Grey, and R. oxycanthoides L.

Ichijima (42) discussed the cytology and genetics of Fragaria and included some of our native species. He found the chromosome numbers to be as follows: F. americana n = 28; F. virginiana n= 28. He also reported F. chiloensis n = 28. This species is not indigenous here but is related to, or is a form of, the native F. glauca.

East (29) stated that the haploid chromosome number of the F. vesca type species is 7, that of F. elatior, 21, and that of F. chiloensis and cultivated varieties, 28. He found that it was easier to cross species with different chromosome numbers when the female parent had the lower number, except between F. elatior and F. chiloensis types.

Longley (48) reported that the dioecious Rubus chamaemorus is hexaploid* with 28 haploid chromosomes. He believed dioecism to be associated with polyploidy.

Longley and Darrow (50) found that triploid and tetraploid raspberries constitute a small, but significant

* This was evidently an error, octaploid probably being intended.

group. R. strigosus has a haploid chromosome number of 7. This count was determined from wild material and is the basic number for the genus.

Amelanchier is not discussed cytologically in the literature. Weigand (80) found wide natural hybridization in the genus in the state of New York. A high percentage of the material examined represented hybrids of six well-defined species. Under natural conditions the species varied little but on land that had been "cut over" or disturbed, the hybrids were in the majority and in a state of flux. Rehder (63) described Amelosorbus, which is a natural hybrid of Amelanchier and Sorbus. This provides an example of inter-generic hybridization. Michurin (56) claimed hybrids of Sorbus and Mespilus.

Longley (47) reported Crataegus rotundifolia (Ehrh) Borckh as one of the few tetraploid species in the genus having 32 gametic chromosomes.

Kobel (44) reported on various species of Prunus and gave the following haploid chromosome numbers: P. serotina Agardh n = 16; P. pumila n = 8; and P. nigra Ait. n = 8.

Dorsey (27) reported P. pennsylvanica and P. americana as having n = 10. He showed that the majority of the plums with which he worked were self-sterile. His work included P. Besseyi, P. americana, and P. salicina.

Becker (5), in work preliminary to hybridization, found that P. pennsylvanica had n = 8 and P. virginiana had n = 16. P. virginiana proved to be self-fertile, setting 0.267 fruits per raceme when selfed and 3.230 ± 0.470 fruits when open-pollinated. Thus, fertility was reduced when the flowers were selfed. P. pennsylvanica yielded 1.3 percent

fruit when self-pollinated and 2.8 percent when open-pollinated.

Okabe (58) reported that Prunus grayana and P. padus both had n = 16 and that of P. tomentosa had n = 8.

Darrow (18) stated that P. tomentosa could be crossed to give fertile hybrids between it and P. triloba, P. Besseyi, and the horticultural varieties Montmorency, Napoleon, and Zumbra cherries.

Angelo and Becker (2) reported n = 38 in the Beta grape, which agrees with the determination of Sax (69) for Vitis vulpina.

No work has been done on Shepherdia, but Sobolervska working in the family Eleagnaceae, found n = 6 for E. angustifolia.

Longley (49) reported the chromosome numbers for some species in the family Vacciniaceæ. The haploid counts were as follows: Gaylussacia baccata 12; Vaccinium canadense 12; V. angustifolium 24. Hagerup (40) gave the haploid numbers of Oxycoccus palustris Pers as 36 and of Vaccinium Vitis-Idaea as 12.

Lagerberg (45) reported n = 8 in Sambucus racemosa. Sax and Kribs (70) worked with Sambucus, Viburnum, and Lonicera. They found gametic numbers as follows: S. canadensis 18: V. trilobum 9; V. opulus 9; L. coerulea 9-18. All of the species of Sambucus with which they worked had n = 18 and of Lonicera coerulea had n = 9 and n = 18.

* 9-18 as reported by author.

Materials and Methods.

The root-tip material was obtained from plants included in the collection referred to in Part I. It was gathered during the summer of 1935 from potted plants which had gained sufficient vigor of growth. Collections from which root-tip material was gathered are marked with an asterisk in Table III.

The root-tips were gathered between 10 A. M. and midday and fixed in Karpechenko's solution. A modification of the methods of Navashin and of the University of California was used. The modification consisted of substitution of N-Butyl alcohol for ethyl alcohol during the final stages of dehydration. N-Butyl alcohol proved to be superior. The material was imbedded in paraffin.

Imbedded material was section 8u to 10u thick and stained with Haidenhain's iron-haematoxylin. The sections were studied with a 90 N. A. 1.25 Zeiss apochromatic objective and numbers 6X, 10X, 15X and 20X compensating oculars. The drawings were made with the aid of a camera lucida using the above mentioned objective and a number 15X compensating ocular. The microscope was raised 6 inches above the table level for all drawings. For photographs the original drawings were enlarged to twice their size and these enlargements reduced one-half on the negative from which the prints were made. This procedure modified outline irregularities.

Methods and Results.

Chromosome counts in Amelanchier were not the same. In an attempt to find some explanation of the variation in number, fruiting-wood was gathered in February. This was placed in water in the laboratory and sprayed twice daily. Smear mounts were made every two days after the flower buds had started to grow, using the usual aceto-carmine solution. When the buds were thought to have advanced sufficiently they were fixed and imbedded as described previously. Before cutting, it was found advantageous to soak the imbedded flower-bud material in water at room temperature for several days. This procedure tended to soften the tissues. The flower-bud material was sectioned at 15u and stained as described for the root sections.

Chromosome Numbers.

In this study the somatic chromosome number has been determined in the following genera and species: Ribes americanum Mill; Rubus pubescens Raf.; Amelanchier sp.; Prunus pennsylvanica; P. melanocarpa; and Shepherdia argentea. It is hoped that the information will be of value in future breeding work.

Fig. 6 Fig. 7

Chromosomes of Ribes americanum Mill (Fig.6) and Rubus pubescens Raf. (Fig. 7). The somatic number is 16 in both cases.

Ribes americanum Mill.-

This is the most widely cultivated of our native species of currant. The somatic number of 16 agrees with the number determined by Meurman (55). No distinctive features were noted, all of the chromosomes being about the same size and shape. They average approximately 2u in length.

Rubus pubescens Raf.-

This species represents a type of dewberry that should be of value for breeding work because hardiness is combined with trailing habit. The sections were made from vigorous root-tips and the figures were very distinct in a transparent cytoplasm. The chromosomes averaged 3.5 u in length and were the largest noted throughout this study. Only root-tip material was examined. The somatic chromosome number was found to be 16.

Fig. 8

Fig. 9

Fig. 10

Figs. 8, 9 and 10, Chromosome numbers of Amelanchier species. The somatic numbers are 64 approx., 26, 33, respectively.

Amelanchier species.-

The specimens given particular study were from collections 1-20-5, 1-20-7 and 1-10-2. In all cases the cytoplasm was very dense, and for microscopic examination intense light was required. The somatic chromosome numbers for these plants were 26, 33 and 64 respectively. The count of the last collection is an estimated number. The figures in material 1-10-5 were the only ones with any morphological distinction, one pair of chromosomes having satellites.

All the plants mentioned had been gathered as A. alnifolia. Plants 1-20-5 and 1-20-7 came from the same location and had been growing under similar wild conditions. Specimen 1-10-2 was outstanding, having been selected by Mr.A. Griffin and cultivated for a number of years at Brooks, Alberta. This latter plant has large deep purple fruits, borne on upright racemes. The fruit ripens about two weeks before that of other Amelanchier collections. The plants have not attained sufficient size to be compared under cultivation. Flower buds have not been produced hence pollen-mother-cell material was not obtained from these plants.

Root-tip material from other collections was studied, notably that of the white saskatoon. It was felt that there was not sufficient material to make any statement as to the number of chromosomes.

In an attempt to check the above varying counts, study of pollen mother cells was made. The anthers of these flower buds were so small that permanent smears could not be made. The anther material was imbedded for future study. During the examination of temporary smears a large percentage of the pollen grains in the tetrad stage was seen to be aborted.

Fig. 11

Fig. 12

Chromosomes of Prunus pennsylvanica (Fig.11) and Prunus melanocarpa (Fig. 12). The somatic numbers are 16 and 32, respectively.

Prunus.-

A study of P. pennsylvanica showed 16 somatic chromosomes. Morphologically, one pair of chromosomes differed from the rest in being distinctly larger. These chromosomes were the smallest of all the chromosome material examined and averaged lu in length.

P. melanocarpa belongs to the subgenus Padus, several species of which have a somatic chromosome number of 32. Counts for the material studied agreed with this

number. One chromosome was peculiar in that it was long and frequently folded back on itself. This made it difficult to decide whether there were one or two chromosomes.

Individual plants of these two species, when cultivated, seldom set fruit. In order to determine their fertility, racemes of both on several trees were enclosed in transparent envelopes similar to those used for cereal crossing. The branches were shaken every day until such time as the flowers wilted. Only one fruit set, and that on Prunus melanocarpa. This one fruit did not reach maturity but withered and died while still on the tree.

Fig. 13. Chromosomes of Shepherdia argentea. The somatic number is 26.

Shepherdia.-

The genus Shepherdia has two species common to the prairies. Shepherdia argentea only, was studied. The somatic chromosome number was found to be 26. The species is dioecious and it was not known if the root-tips were taken from a male or female plant. No hetero-

chromosomes were found, but the chromosomes were remarkably well paired and averaged 3u in length.

Summary

In the seven species studied, the somatic chromosome numbers were found to be as follows:

Ribes americanum Mill.	-	16
Rubus pubescens Raf.	-	16
Amelanchier species.	-	26
	-	33
	-	64 approx.
Prunus pennsylvanica L.	-	16
Prunus melanocarpa (A. Nels) Rydb.	-	32
Shepherdia argentea Nutt	-	26

Evidence indicated that Prunus pennsylvanica and Prunus melanocarpa materials studied are either self-sterile or nearly so.

An explanation of the results with Amelanchier may be that the five species mentioned in the literature have a wider range of distribution than previously realized and that natural hybridization has taken place.

[illegible] [illegible] [illegible] [

GENERAL SUMMARY.

Each of the three parts of this study has been summarized at the end of its respective section. Certain features which appear to be outstanding are mentioned here. For every problem that has been investigated many related ones have been suggested which impresses the writer with a realization of the opportunities for research in this field.

The study has shown that wild fruits with desirable characteristics are available in the prairie provinces. The collections made during the progress of the problem represent outstanding plants. Use of the selections in hybridization work should mark a forward step in hardy fruit development.

Propagation of these native fruits from seed has been shown to be practical. This is a prime fundamental in a fruit improvement project.

Chromosome numbers for certain species have been determined. An unexpected problem has arisen in Amelanchier. It seems possible that the five wild species represented have a wider range of distribution than previously realized and that natural hybridization has taken place.

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